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QUARTERLY

OF THE

National Fire Protection Association

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Western Factory Insurance Association.
Western Sprinkled Risk Association.
Western Underwriters Association.
West Virginia Fire Underwriters' Association.
West Virginia Inspection Bureau.
Wisconsin Inspection Bureau.

Over 4,600 Associate Members.

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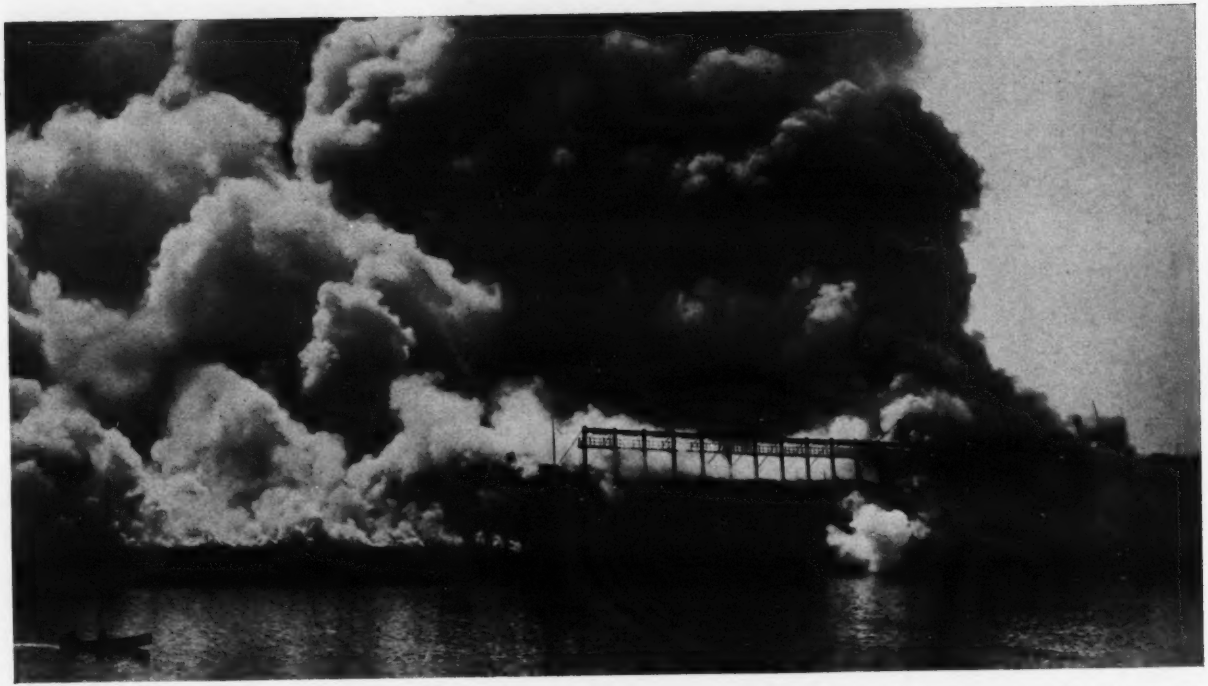
Reports of fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.



International.

The burning of the Rhode Island State pier, Providence, on Feb. 25, 1931. The pier superstructure was of steel and concrete construction, but the substructure was of wood. Recognizing the fire hazard of a large undivided pier shed housing valuable contents, the State authorities installed a complete automatic sprinkler system for the pier shed, but omitted all protection from the under-deck space. This space, unsprinklered, not subdivided by fire walls or draft stops of any kind, and provided with no means of access for fire fighting, was where the fire originated, with the results shown above. (See report on page 439.)

The Quarterly

Vol. 24 April, 1931 No. 4

The Thirty-fifth Annual Meeting. The thirty-fifth annual meeting of the Association, to assemble at the Hotel Royal York, Toronto, May 11, 12, 13 and 14, will be the second convention to be held in a Canadian city. Canadian meetings serve to emphasize the international scope of the Association's activities and to give recognition of the devoted service in the cause of fire prevention rendered by our Canadian members. The National Fire Protection Association, though it was organized and maintains its headquarters in the United States, is truly an international organization, and in proportion to the relative populations of the two nations, the Association has been as strongly supported by membership in the Dominion as in the States.

Toronto is only an over-night railroad journey from eastern and central centers of population, and with the special trains from Chicago and New York everything is arranged for the convenience and pleasure of members traveling to the meeting. The Hotel Royal York, the newest of the chain of hotels operated by the Canadian Pacific Systems, offers most comfortable accommodations for the visitor.

Our Canadian director, Mr. George Lewis, and other Toronto members, are sparing no effort for the success of the meeting. A most interesting series of entertainment features has been arranged, culminating in an all-day trip on Friday, May 15, to the Welland Canal, and the Hydro-Electric plant at Niagara Falls. Members, delegates, and members of their families will be guests of local organizations at all these functions through the unusual generosity of our Toronto hosts. These entertainment features, however, will not interfere in any way with the regular program of the meeting, and the Toronto gathering, like all N.F.P.A. annual meetings, will be a "working convention."

* * * * *

Generous Minneapolis. A few years ago some zealous citizens of Minneapolis who were concerned about the city's fire losses and desired to reduce them, introduced an ordinance designed to abolish the use of wooden shingles as roof coverings. Letters from a dozen of the leading fire chiefs of the country were presented certifying that the wooden shingle, where permitted to be used, was the principal cause of fire and a per-

sistent spreader of conflagrations. Circumstantial city reports of sweeping fires of great magnitude demonstrating the conflagration hazard of shingle roofs were laid before the Minneapolis authorities.

Then came the lumbermen with the amazing representation that while the wooden shingle if sawed in one fashion was an undoubted offender, if sawed in another fashion it lost all its hazardous properties. It depended upon how a board was cut whether it would burn or not. The Minneapolis City Council was impressed by the force of this statement even if it could not be comprehended by finite intelligence. It voted to continue to permit the use of wooden shingles on Minneapolis roofs so long as they were sawed all right.

The report of the Minneapolis fire department for the year 1930 is now available. It shows for that year a total of 553 fires in wooden roofs. The city's total fire loss for the year was $1,511,903.39, but the portion due to wooden shingles is not determined. As the loss on frame buildings is reported as $422,160.37 perhaps this may be an indication. According to the department's tabulations the average cost per alarm of fire in 1930 was $238.30. This made the 553 wooden shingle fires cost the city $131,780 in responding to the alarms alone, a very generous contribution of the taxpayers of Minneapolis to maintain a market in their city for wooden shingles. (One of the arguments before the Council was the obligation to do justice to a great industry.)

There are several considerations which do not appear in these statistics. Every citizen who puts wooden shingles on his roof pays a warranted additional insurance premium in the policies of his home and contents. The charge for this hazard throughout the country probably averages between ten and fifteen cents per hundred dollars of insurance. He thus goes on paying annually for his roof as long as it lasts after he has bought it of the lumberman. Where wooden shingles are permitted, this fire hazard is also figured in the base insurance rate of the community as it properly should be. All the policyholders of the city share in this contribution to the lumber business, making up a very tidy sum. As most of them do not know this, however, they should not be given too great credit for generosity.

In addition to the increased cost of maintaining the fire department resulting from the use of wooden shingles, is the danger to life and property involved in 500 additional runs of apparatus a year through the city's traffic, and the possible conflagration due to the diversion by any of these senseless demands of the attention of the department from more important fire calls. When one considers these dangers and the accumulation of charges and costs met annually by the citizens to maintain the shingle market, one wonders if without impairing that generosity it would not be more businesslike for Minneapolis to budget its wooden shingle expense and pay its assessment in a lump sum to the industry.

All in the Application! The increasing number of comparatively worthless devices sold to the public as fire extinguishers places a considerable burden of correspondence upon our members whose counsel is sought by friends and constituents whose common sense may have been temporarily suspended by the extravagant claims of persons selling such devices. Any device which is not classified for use in designated situations or upon special types of fires lends itself easily to wild exaggerations as to its effectiveness as a fire extinguishing agent. Letters from people of considerable experience in fire prevention matters exhibit unbelievable credulity after exposure to a barrage from some high-pressure salesman working for a commission.

The fire prevention engineer of a leading railroad company recently addressed our member, the Railroad Insurance Association, inquiring after the merits of one of these devices whose salesman had impressed upon his attention a bewildering array of testimonials. Mr. de Witt Rapalje replied to the letter of inquiry:

> In answer to your inquiry I would comment as follows:
>
> A Connecticut Yankee once manufactured a flea powder which he guaranteed was sure death to all fleas. One customer purchased a supply and sprinkled it generously within the dog kennel, but his dog did not obtain any relief from the unwelcome visitors. The customer therefore complained that the flea powder did not work, but the manufacturer said:
>
> "I am afraid you have not followed all the directions, which are as follows: First you catch the flea, pinch him hard on the hind legs until he opens his mouth wide, then throw the flea powder down his throat and he will choke to death.
>
> "This flea powder is fully guaranteed if you personally see to it that it is applied in the right place at the right time."

It is Mr. Rapalje's opinion that there are situations in life in which no amount of personal expert advice or number of inundations of other people's enthusiasms will solve a man's problem; he must perforce exercise a little of his own common sense.

* * * * *

Earthquakes and Fire. Reports of the Managua, Nicaragua, earthquake, received as the QUARTERLY goes to press, indicate that fire has again followed a major earthquake and completed the destruction of a city. It is often difficult to evaluate the relative losses from earthquake and fire in such a disaster, but it appears that in many cases the fire loss may be greater of the two. Serious though the effects of the earthquake, the damaged buildings could be repaired, and the life of the city could go on, were it not for the ensuing fire. San Francisco, this month commemorating the twenty-fifth anniversary of her disaster of 1906, speaks often of the conflagration, but seldom mentions the earthquake. This is perhaps due in some measure to the reluctance of her "boosters" to admit that their city is subject

to earthquake shocks, but is probably more largely a reflection of the actual happenings of 1906. It was fire, not earthquake, that destroyed the city. If the water mains had not been ruptured the city's firemen would doubtless have been able to extinguish in their incipiency the fires that followed the earthquake, and the events of April, 1906, would now largely be forgotten instead of occasioning impressive commemorative exercises. San Francisco learned her lesson, and following the fire installed an earthquake proof fire protection system, but other cities subject to a similar potential hazard would in many cases be rendered helpless were a single water supply to be broken by an earthquake shock.

Santa Barbara escaped fire disaster following an earthquake in 1925 by the prompt action of the municipal authorities in cutting off the gas and electric services, and thus largely eliminating possible causes of fire. Many buildings were damaged, and as is usual in such cases inferior construction suffered particularly, but no sweeping fire followed, the damage was promptly repaired, and the city soon resumed its normal existence.

The most serious loss of life by fire recorded in modern times followed the Japanese earthquake of 1923. As described by reports on file in the N.F.P.A. Executive Office, the loss of life was more than one hundred thousand. It was impossible to determine what proportion of the casualties was due to the earthquake and what to the ensuing fire that swept Tokyo, but a single incident shows the part that fire played and the indescribable horror of the disaster. Following the initial shocks, some thirty-four thousand people took refuge in an open square, thinking there to be safe from the danger of falling walls and the fires that had already begun to kindle in the ruins. But the fires spread and soon merged into a general conflagration that enveloped the square on all sides, and the thirty-four thousand were cremated.

The New Zealand earthquake, described in detail in this issue of the QUARTERLY, furnishes further evidence of the part that fire plays in such disasters. Here, again, fires broke out in the ruins, the water supplies failed, and the firemen were helpless to arrest the conflagration. Buildings that suffered little or no damage from the earthquake were swept by the fire, which in many cases nullified the value of earthquake resistive construction.

There are many cities throughout the world located in zones where major earthquakes are possible. It may not be feasible in such cities to compel the general adoption of earthquake resistive types of construction, but prudent provision for public safety at least calls for the adoption of San Francisco's idea of installing a fire protection system designed to retain its effectiveness in any emergency.

Meeting of Board of Directors.

January 17, 1931.

The midwinter meeting of the Board of Directors was held in Atlantic City, January 17, 1931. The following members were present:

Albert T. Bell, Atlantic City, Chairman
Frederick T. Moses, Providence, President
Sumner Rhoades, New York, Vice-President
Harold L. Miner, Wilmington, Vice-President
Franklin H. Wentworth, Boston, Managing Director

Eugene Arms, Chicago
George W. Elliott, Philadelphia
C. H. Haupt, Elizabeth, N. J.
W. F. Hickey, New Haven, Conn.
George F. Lewis, Toronto, Ont.
W. E. Mallalieu, New York
S. D. McComb, New York
S. L. Nicholson, New York
C. W. Pierce, New York
David J. Price, Washington
Benjamin Richards, Chicago
Richard E. Vernor, Chicago

Mr. A. R. Small, N.F.P.A. representative American Standards Association, was present by invitation.

Business Transacted.

The program for thirty-fifth annual meeting, Toronto, May, 1931, was discussed and referred to the Program Committee.

Informal reports were received on Field Service Activities and the status of advertising in the QUARTERLY.

The matter of solicitation of membership was discussed and the chairman was authorized to appoint a committee of five to report to the next meeting of the Directors for consideration a suggested plan for reclassification of Association memberships. The following committee was appointed: H. L. Miner, chairman, F. T. Moses, Sumner Rhoades, S. D. McComb, R. E. Vernor.

Following discussion of report by A. R. Small, official representative N.F.P.A. in American Standards Association, it was unanimously *voted* heartily to endorse Mr. Small's acts and attitudes in the past as our representative and his proposed future attitude respecting matters of policy now advanced for A.S.A. consideration; and to express cordial appreciation of his conscientious and devoted service to the N.F.P.A. in this connection.

It was voted to delete immediately from regulations governing First Aid Fire Appliances paragraph 71, referring to dry powder tubes and hand grenades.

Revision of the text of the Flammable Liquids Ordinance was discussed and the Chairman of the Flammable Liquids Committee reported the project already under way.

The items concerning the Committee on Signaling Systems referred to the Directors by the Association (Proceedings Annual Meeting, 1930, pages

246-249) were discussed and referred to the Chairman of the Committee on Signaling Systems.

It was voted that representation of the International Association of Accident Boards and Bureaus upon the Electrical Committee N.F.P.A. be granted.

Informal reports were received concerning the progress of the Forest Committee, the Committee on Fumigation, and the Committee on Spontaneous Heating and Ignition.

Revisions of Technical Regulations.

Committee on Flammable Liquids.

The Association at its annual meeting of 1930 authorized this committee to submit to the Directors for adoption further amendments to the regulations governing Oil Burning Equipments (Proceedings 1930, p. 416).

In accordance therewith the following recommendations were adopted (Refer to 1928 edition of Regulations for Installation of Oil Burning Equipments):

Page 10, Rule 14 (d): Insert new sentence at the beginning of this paragraph to read as follows:

"Steel tanks in units of not over 275 gallons capacity each having aggregate capacity not in excess of 550 gallons, may be installed without enclosure."

Reword the first sentence of the present paragraph to read:

"Steel tanks, except as permitted above without enclosure, shall be placed . . . etc., etc."

Page 21, Rule 121 (b): Revise first paragraph to read as follows:

"When located inside the building the capacity and protection of the tanks shall be in accordance with the provisions of Rules 14 and 25 of the preceding Regulations for Oil Burning Equipments . . . etc., etc."

Page 25, Rule 128 (a): Revise the first sentence to read as follows:

"Gravity feed to burner from auxiliary tank or storage tank of not over 275 gallons capacity may be permitted if suitable automatic safeguards are provided to prevent abnormal discharge of oil at the burner."

Committee on Manufacturing Risks and Special Hazards.

On recommendation of the Committee on Manufacturing Risks and Special Hazards, amendments in the Regulations for Ovens for Japan, Enamel and other Flammable Finishes (Proceedings 1930, page 351) were approved. These changes are in addition to those adopted at the 1930 annual meeting. The committee recommended no change in par. 151 (see discussion Proceedings, p. 361). The changes are as follows:

Pars. 104 and 105 renumbered 102 and 103.

New pars. 104 and 105 as follows:

"All proposals for new ovens or remodeling of existing equipments should specify that all details are in conformity with these regulations."

"Plans and specifications should be submitted for approval to the Inspection Department having jurisdiction."

112. Revise second line to read: "and finished, and shall be separated from important power."

122. First and third line change "should" to "shall."

148. Note (b) third and fourth line delete "twice the ventilating capacity is necessary or"; insert following "air" the words "are necessary." Insert additional paragraph (c) reading: "Unless data are available on the actual surface covered, per gallon of japan, lacquer, etc., as used, coverage should be figured at not over 300 sq. ft. of surface per gallon of finishing material, paints containing about 65% solvent, lacquers about 75% solvent."

Revise section on heating beginning par. 151 to incorporate all general material under a new heading, 151 General.

158 change number to 151 (f). Change "burners" to "heaters."

(a) renumbered 1. Revise to read: "Interconnection of the fuel or current supply with the ventilating system to prevent operation of the heaters without proper ventilation of the oven."

(b) renumbered 2. Revise first line to read: "Interconnection of the fuel supply with any supply of compressed air for."

(d) renumbered 4. Revise first line to read: "A reliable pilot light or electric igniter shall be provided for gas or oil burners and should be."

153 renumbered 152. Change word "should" to "shall"; delete "well above the floor"; insert "see also Rule 151." (Reference to Rule 151 also inserted following paragraphs on other types of heating.)

159 (b) renumbered 158 (b). Insert "where necessary" following word "screens" on second line.

(c) revise to read: "Heating elements shall be located at the sides or top of the oven."

184. Add Note: "This is because at temperatures above 250° F. condensate from finishes will cause loading or coating of sprinklers."

188 and 188 (b) change 200° F. to 175° F.

(c) Explanation of formula, replace "coefficient of sharp edge orifice" by "coefficient determined from tests."

208 (a) change "should" to "shall"; (b) insert "intentional" following the word "such" in the third line.

The following revisions of and additions to the personnel of various committees were confirmed:

Automatic Sprinklers:

G. A. Russell, Board of Fire Underwriters of the Pacific

Aviation:

B. H. Phister, Chemical Fire Extinguishers Association, Inc.

Building Construction:

Frank Burton, Steel Joist Institute

Construction Operations:

Frank H. Alcott, National Lumber Manufacturers Association

Dust Explosion Hazards:

E. G. Bailey, Pulverized Fuel Equipment Association
F. W. Sehl, National Bureau of Casualty and Surety Underwriters
C. E. Wood, Society of Grain Elevator Superintendents of N. A.

Electrical:

George O. Moores, American Railway Association
Frank Thornton, Jr., National Electrical Manufacturers Assn.
H. S. Warren, Telephone Group, A.S.A.

Electric Railway Car Houses and Cars:

R. Driscoll, Canadian Fire Underwriters Association
H. R. Markel, International Association of Electrical Inspectors

Field Practice:

A. O. Boniface, Chemical Fire Extinguishers Association, Inc.

Forest:

A. H. Blackett, Chemical Fire Extinguishers Association, Inc.
Edward S. Brashears, American Automobile Association
Nelson C. Brown, Izaak Walton League of America, Inc.
Ovid Butler, American Forestry Association
C. S. Chapman, The Society of American Foresters
J. D. Coffman, National Park Service
S. O. Cook, Fire Apparatus Manufacturers Association
Fayette B. Dow, American Petroleum Institute
W. B. Greeley, American Engineering Council
Roy Headley, United States Forest Service
Hathaway G. Kemper, Associated Lumber Mutual Fire Insurance Cos.
J. P. Kinney, Indian Bureau
Charles H. Lum, National Board of Fire Underwriters
Edward E. Minor, American Water Works Association
John B. Nash, American Paper and Pulp Association
Franklin W. Reed, National Lumber Manufacturers Association
Philip E. Rice, American Hotel Association
George J. Richardson, American Federation of Labor
H. B. Shepard, United States Forest Service

Fumigation Hazards:

Eugene Arms, Chairman, Mutual Fire Prevention Bureau
E. A. Back, United States Department of Agriculture
J. I. Banash, National Safety Council
E. C. Duff, Canadian Fire Underwriters Association
P. W. Edwards, United States Department of Agriculture
E. W. Fowler, National Board of Fire Underwriters
A. W. Gunnison, Board of Fire Underwriters of the Pacific
R. D. Hobbs, Western Actuarial Bureau
H. L. Miner, Manufacturing Chemists Association of the United States
A. H. Nuckolls, Underwriters' Laboratories
R. C. Roark, United States Department of Agriculture
H. S. Smith, Compressed Gas Manufacturers Association

Garages:

A. H. Blackett, Chemical Fire Extinguishers Association, Inc.

Gases:

C. C. Spreen, National Electrical Manufacturers Association

Hazardous Chemicals and Explosives:

F. S. Lodge, National Fertilizer Association

Marine:

F. T. Wright (replacing M. M. Brandon), Underwriters' Laboratories

Piers and Wharves:

Billings Wilson, American Association of Port Authorities

Protection Against Lightning:

Edward Beck, National Electrical Manufacturers Association
V. E. Goodwin, National Electrical Manufacturers Association
W. J. Humphreys, Weather Bureau, U. S. Department of Agriculture

Protection of Openings in Walls and Partitions:

M. J. O'Brien (replacing R. K. Porter), Underwriters' Laboratories

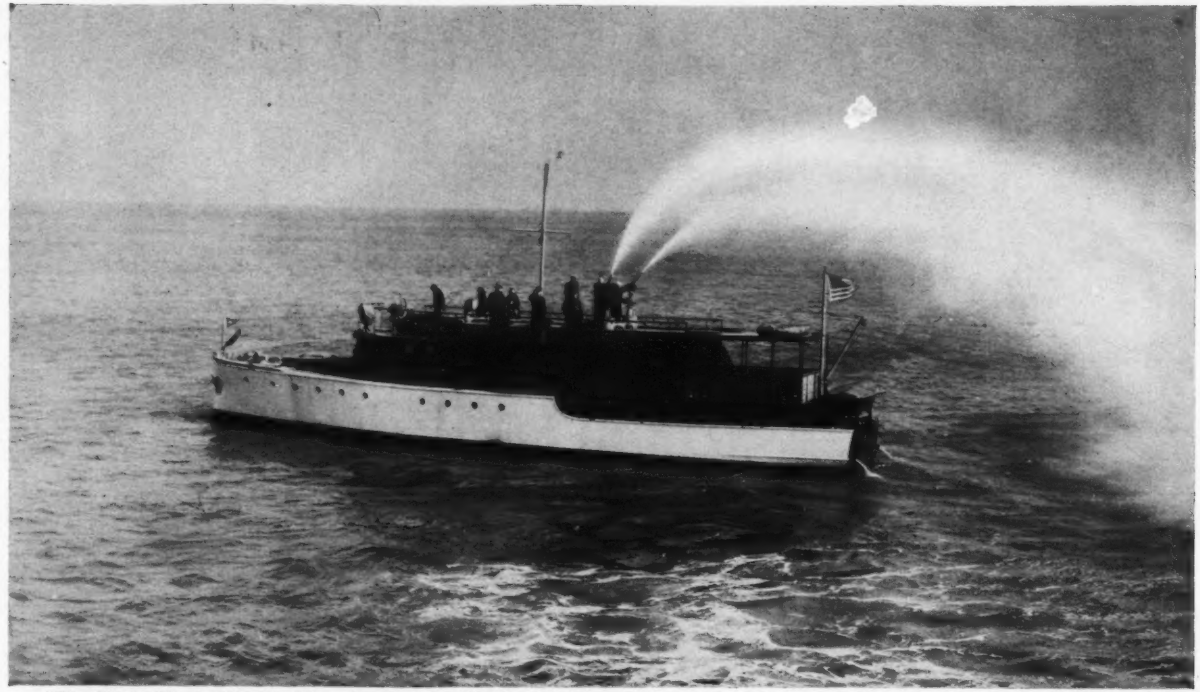
Protection of Records:
A. J. Steiner (replacing R. K. Porter), Underwriters' Laboratories
Signaling Systems:
F. T. Wright (replacing M. M. Brandon), Underwriters' Laboratories
Tanks:
A. L. Brown (replacing C. D. Abbott), Chairman
American Standards Association Committee Appointments:
Grandstands, Nolan D. Mitchell, N.F.P.A. Representative
Pressure and Vacuum Gauges, A. R. Small, N.F.P.A. Representative
Standardization of Fuel Oils, N. J. Thompson, N.F.P.A. Representative

The Bluebell.

The *Bluebell,* the first pleasure craft ever equipped as a fireboat, is the unique conception of her owner, Albert T. Bell of Atlantic City, Chairman of the Board of Directors of the National Fire Protection Association. Mr. Bell's hobbies and principal interests, in addition to his regular duties as director of the Hotels Haddon Hall and Chalfonte at Atlantic City, are fire protection and yachting. When it came to the design of a yacht for Mr. Bell, it was not surprising that these two hobbies should be combined in a unique manner. The *Bluebell,* developed as the result of years of thought by her owner, was constructed during the past year and launched at Lower Bank, N. J., in November 1930. She is 76 feet overall and 15 ft. beam. Fire-safety has been uppermost in Mr. Bell's mind in the planning of the boat. She is a comfortable and seaworthy craft designed to be capable of cruises to Labrador or other distant places, but comfort and convenience have in no detail of design been allowed to interfere with fire-safety. The *Bluebell* is a model in respect to the elimination of all possible fire hazards and the provision of extinguishing equipment to handle any fire that might originate on board, and in addition to this is equipped as an amateur fireboat to bring aid to other craft or waterfront property where the *Bluebell* is cruising.

The first step in the planning of the boat was to do away altogether the gasoline hazard, which has been responsible for so many disastrous yacht fires and explosions, and which cannot be completely eliminated where gasoline is the fuel, despite all precautions that may be taken. Diesel engines were accordingly selected for the power plant. Diesel engines employ a high flash point fuel oil, which eliminates the gasoline hazard. The two 300 horse power Diesel engines installed, like many other features of this unique craft, were especially constructed for the *Bluebell.*

The next point of fire hazard considered was the cooking and heating arrangements, likewise a frequent fire cause on present-day yachts. All open



"The Bluebell" of Atlantic City—the first fire fighting yacht ever launched. The owner, Mr. Albert T. Bell, Chairman of the Board of Directors of the National Fire Protection Association, may be seen at the starboard monitor nozzle.

flame devices were eliminated by complete electrical equipment of the galley. Electricity is likewise employed for heating—not a direct system with electric heaters which might themselves be potential sources of fire, but an indirect hot water system where hot water is heated electrically by safely enclosed heating units located in the engine room, and then circulated to heat the cabin. The *Bluebell* is the first yacht to employ this modern electrical system of cooking and heating.

Not content with eliminating potential fire causes on board in connection with the power plant and cooking and heating equipment, Mr. Bell installed a complete carbon dioxide smothering system for the engine room and galley. This includes a reserve of storage of cylinders of the gas so that any single fire on board can be handled by use of half of the storage carried. This permits maintaining the same protection after a fire, and assuming a fire to occur and be extinguished by this fire protection equipment while the *Bluebell* was on a cruise, there would still remain a full carbon dioxide supply to maintain protection to handle a possible second fire. In addition to the fixed smothering system, suitable hand extinguishers are strategically distributed.

The large amount of electrical equipment, which includes in addition to heating and cooking, electric lighting, refrigeration, dish washing, bathroom, and other equipment, calls for a substantial electric power plant, and a 75 kw. electric generator is clutch connected to the forward end of each Diesel propelling-engine. Arrangement is provided so that when the *Bluebell* is tied up at her wharf the electric equipment can be supplied through a temporary connection from the city electric service. Among the many modern auxiliaries one of particular interest to the landsman is the gyroscopic compass and gyropilot for automatic steering, which automatically keeps the boat on any set course.

As the design of the boat developed on the drafting board, the thought came to Mr. Bell that he had in this boat a very substantial power plant located always immediately over billions of gallons of water, and only a small additional amount of equipment would be needed to make the *Bluebell* an effective fire-fighting unit. Accordingly two 75 H.P. motors were installed in the engine room with a 300-gallon centrifugal pump on each end of each motor, giving a total rated fire pump capacity of 1200 gallons per minute, connected to the two monitor nozzles which may be seen in the accompanying picture. Fire department hose connections are also provided so that the *Bluebell* may coöperate with land fire-fighting forces in handling fires near the shore. Mr. Bell plans during the coming summer to navigate his unique yacht to a number of harbors and demonstrate to marine and municipal officials the effectiveness with which a private yacht may be used to fight waterfront fires.

U. S. Fire Losses for 1929 and 1930.

Compiled by National Board of Fire Underwriters.

The United States fire losses for 1929 were $459,445,778, according to the final figures of the Actuarial Bureau of the National Board of Fire Underwriters published in the winter issue of *Safeguarding America Against Fire.* This figure supersedes the original estimate of the 1929 fire loss made by the National Board as published in the July, 1930, QUARTERLY, page 31.

American Fire Losses Compared, 1928-1929.

Causes	Recorded Loss 1928	1929
Matches—Smoking	$27,902,919	$27,971,339
Defective Chimneys and Flues	19,588,878	19,835,311
Stoves, Furnaces, Boilers and Their Pipes	19,311,169	19,818,395
Electricity	14,905,816	13,619,687
Sparks on Roofs	12,932,552	11,806,345
Petroleum and Its Products	12,207,297	12,681,364
Spontaneous Combustion	12,112,461	12,211,071
Lightning	7,708,530	7,494,357
Hot Ashes and Coals	4,953,769	4,809,536
Open Lights	4,909,768	3,454,534
Sparks from Combustion	4,401,368	3,369,543
Sparks from Machinery	3,478,454	5,955,303
Miscellaneous Known Causes	3,397,498	3,322,201
Rubbish and Litter	2,939,182	1,229,420
Gas, Natural and Artificial	2,561,934	2,174,891
Incendiarism	2,466,034	1,959,549
Ignition of Hot Grease, Tar, Wax, Asphalt, etc.	2,109,299	2,174,907
Explosions	1,147,631	1,936,860
Fireworks, Firecrackers, etc.	693,996	729,060
Steam and Hot Water Pipes	407,319	324,390
*Exposure (including Conflagrations)	41,219,494	37,112,890
Unknown Cause	170,330,314	173,565,669
Total	$371,685,682	$367,556,622
25% to Cover Unreported Losses	92,921,420	91,889,156
	$464,607,102	$459,445,778

1930 Losses.

Fire losses for 1930 are estimated by the National Board at $463,612,762. This figure, determined since the publication of the January QUARTERLY, is approximately 0.5% less than the preliminary estimate which appeared in that issue, (See QUARTERLY, January, 1931, page 249). The original estimate was based on figures compiled by the National Board for the eleven months ended November 30, 1930, with an estimate for December

*Losses due to spreading of fires originating from various causes.

based on the experience of previous years. The following are the monthly totals for 1930 released by the National Board:

January	$42,344,035	August	$36,043,679
February	43,206,940	September	35,230,456
March	42,964,392	October	36,838,614
April	43,550,996	November	35,682,577
May	38,415,142	December	42,669,915
June	31,818,266	Total	$463,612,762
July	34,847,750		

Comparison of U. S. Fire Losses, 1928-1929, by States.

State	Recorded Loss 1928	Recorded Loss 1929	State	Recorded Loss 1928	Recorded Loss 1929
Alabama	$5,018,250	$5,131,846	New Hampshire	$2,309,508	$2,015,020
Arizona	5,153,964	1,070,841	New Jersey	14,429,161	16,239,208
Arkansas	1,250,067	4,772,541	New Mexico	797,243	712,545
California	19,191,422	20,029,444	New York	46,096,581	48,914,772
Colorado	2,128,957	1,811,578	North Carolina	6,848,123	7,009,859
Connecticut	4,577,505	4,629,889	North Dakota	1,532,200	2,012,515
Delaware	346,685	338,697	Ohio	19,807,916	16,954,557
Dist. Columbia	568,066	1,131,465	Oklahoma	5,916,802	5,378,953
Florida	5,750,643	4,971,360	Oregon	3,805,934	4,156,879
Georgia	6,127,650	5,816,829	Pennsylvania	25,007,634	28,297,589
Idaho	1,223,376	1,329,981	Rhode Island	2,511,645	2,868,634
Illinois	26,018,706	26,408,520	South Carolina	3,883,396	3,468,925
Indiana	9,162,604	8,899,241	South Dakota	1,428,841	1,267,630
Iowa	5,018,066	6,091,855	Tennessee	8,364,477	7,496,438
Kansas	5,814,344	4,281,574	Texas	18,087,207	18,791,081
Kentucky	6,196,713	5,590,307	Utah	1,029,962	650,408
Louisiana	7,666,351	5,961,937	Vermont	1,054,919	786,219
Maine	3,666,892	3,477,978	Virginia	5,617,637	6,071,476
Maryland	5,186,973	3,808,790	Washington	6,592,812	7,941,319
Massachusetts	20,376,808	17,842,736	West Virginia	4,283,366	3,651,330
Michigan	13,498,649	13,914,353	Wisconsin	7,609,312	7,743,726
Minnesota	7,054,107	6,409,868	Wyoming	434,028	390,543
Mississippi	5,135,013	4,647,607	United States	$371,685,682	$367,556,622
Missouri	12,287,782	10,800,594	25% for Unreported Losses	92,921,420	91,889,156
Montana	2,451,831	1,751,131	Total	$464,607,102	$459,445,778
Nebraska	3,078,234	3,322,816			
Nevada	287,320	493,218			

Annual Fire Losses in the United States from 1912 to 1930 Inclusive.

1912	$206,438,900	1922	$506,541,001
1913	203,763,550	1923	535,372,782
1914	221,439,350	1924	549,062,124
1915	172,033,200	1925	559,418,184
1916	258,377,952	1926	560,548,624
1917	289,535,050	1927	478,245,620
1918	353,878,876	1928	464,607,102
1919	320,540,399	1929	459,445,778
1920	447,886,677	1930	463,612,762
1921	495,406,012		

Water Supplies in the Drought Regions.

The drought of 1930, and the continuing deficiency in precipitation during the early months of 1931, appear likely to affect municipal water supplies for some time to come, the water shortage continuing even after a return of normal rainfall conditions. Ground water levels respond slowly to changes in surface water conditions, and it may take a long time for them to return to normal after the depletion of the past year. Variations in ground water level are of most immediate effect on municipal supplies where the source of water is from wells, but through the flow of springs and streams the ground water conditions are also directly reflected in public water supplies drawn from rivers and streams.

The public concern over the sufficiency of water supplies in the drought regions has thus far been principally directed towards the domestic and industrial use of water, but an even more serious situation may arise with respect to water supplies for fire protection, bearing in mind in the smaller communities as great a proportion as eighty per cent of the capacity of the water storage and distribution system may be required for fire protection. Some communities are so located that supplementary water supplies, unfit for domestic use, may be drawn upon in an emergency for fire extinguishment, but the great majority of communities are so situated that their only reliance for fire protection is the public water supply system. The drought is ordinarily thought of as confined largely to the Central and Southern States, but even New York City is affected, and is taking emergency measures to supplement her water supply. A recent large garage fire near the New York waterfront, requiring the use of unusual quantities of water, was handled without drawing on the city supply, by the expedient of using salt water pumped from the harbor by a fireboat and relayed through hose lines by fire department pumpers.

Despite some local rains in the drought regions, the deficiency of water supplies continues to cause concern, particularly in some of the South Central States, where the rainfall last summer was 50 per cent or less of normal. A field survey made by the *Engineering News-Record* shows that many communities are entering the 1931 season with reserves depleted or entirely exhausted and with little prospect as yet of a return to normal. Some cities drawing their supply from wells that were not appreciably affected in 1930, may suffer during 1931 even though there should be ample rainfall this season, owing to the lag between rainfall and ground water levels.

The drought was unquestionably a contributing factor in the increased fire losses of 1930, and it appears that it may also be reflected in the fire loss figures for 1931.

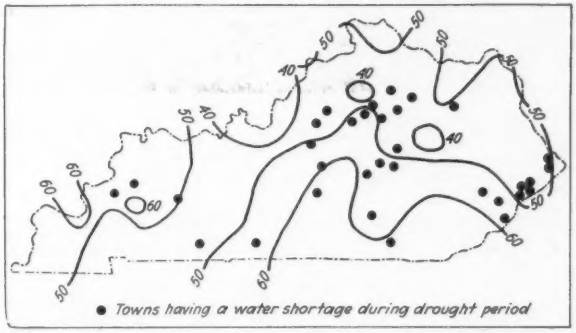
Kentucky Water Supplies.

Kentucky is one of the States that has suffered most seriously. Quoting from the *Engineering News-Record's* survey:

At the peak of the drought period one-third of the public water supplies of Kentucky had been forced to institute emergency measures to assure service to their consumers.

The drought started in Kentucky in March of last year. Rainfall was well above normal in January and at just about its expected value in February, but the remaining months of the year showed deficiencies of such magnitude that the year's total was but 27.55 in., or 61 per cent of its normal value. Prior to 1930 the driest year on record had been 1894, with 34.81 in. For the last ten months of the past year the state received only 50 per cent of its normal rainfall. The driest section was Jefferson County, containing Louisville, and the wettest was in the southeast, near the Tennessee border. It was in the "blue-grass" region of north central Kentucky that water plants were most seriously affected.

In that region runoff is immediate and practically complete because of the rather impervious nature of the clay subsoil. Consequently river stages began to drop rapidly as the drought progressed, until many of the streams became completely dry in the summer with the exception of a few pools scattered along their courses. Two of the larger streams, the Licking and the Salt rivers, also became dry during the summer.



Engineering News-Record.

Kentucky rainfall during the drought. The figures are the per cent of normal rainfall from March 1 to Nov. 1, 1930.

Lexington, Kentucky, was the largest city affected in this region. Measures to curtail the consumption were instituted, but with the steadily dwindling water levels, some emergency supply was necessary. The only adequate source available was the Kentucky River, six and a half miles away. Construction of a 20-in. pipe line and an emergency pumping station at the river was begun in October and was ready to put into service on December 10.

Lancaster, fifty miles south of Lexington, shut off its pumps on Feb. 4, and according to the latest reports, received about the middle of March, has not yet resumed pumping. The town has an elevated tank which was filled

Engineering News-Record.

An emergency supply for Lexington, Kentucky, was taken from the Kentucky River and delivered through a 20-in. pipe line to the city pumping station, 6½ miles away.

with the last few gallons left in the reservoir. All the town's domestic services were then shut off, and the tank kept for protection for at least one fire.

Water by Tank Car.

Communities in many parts of the drought areas have resorted to tank car shipments of water, or have made plans for tank car delivery if the situation becomes more acute. Tank car supplies of water figure frequently in fire-fighting operations in some of the arid regions of the West, but this is a new development in the Central and Eastern States. Probably the first community in the drought region to resort to tank car supply was Shelbyville, about thirty miles from Louisville, Kentucky. On August 7, 1930, delivery of water was started from Louisville. Sixteen cars of 10,000-gal. capacity each were received daily until February, when light rains replenished the storage. In Illinois a number of communities made arrangements for tank car deliveries of water, but in most cases water rationing plans, and the stopping of the use of water for other than domestic service, made it unnecessary to fall back upon the tank car supplies. Water supplies for tank car shipment were available in most cases at moderate distances, but in some instances a

Engineering News-Record.

The first shipment of water arriving in Richmond, Kentucky. Tank car shipments of water maintained the fire reserve in the reservoir.

very considerable rail haul was involved. Spencer, West Virginia, for example, brought its water by tank car over a distance of more than sixty miles.

Fire Supply Reserves.

Conflagrations in the drought regions have probably been avoided by the wisdom of local authorities in setting aside fire reserves and not drawing upon these for ordinary use. Richmond, Kentucky, considered the last 10,000,000 gallons in the reservoir as a fire reserve, and when the supply was depleted to this point started tank car shipments.

Through the chlorination and other treatment of impure water supplies drawn on in the emergency, together with the special efforts of the health authorities, no epidemics have followed the water shortage, but industrial plants in many localities, deprived of process water, have suffered severely. Richwood, West Virginia, presented the tragic picture of an entire town put out of business by the drought from July until December. The town's population of six thousand is supported by three industries—a pulp mill, a lumber company and a tannery. When the river dried up the entire industrial life of the community stopped.

Mill Fire Pumps Assist Public Supplies.

Cross connections between city water supplies and mill fire supplies, in more than one instance during the past year have made it possible to maintain pressure on city mains that would otherwise be with little or no pressure. Clayville, New York, was without water when a hotel took fire and burned to the ground on January 9, 1931. A mill fire pump was then pressed into service, and by removing the clappers from the all-bronze double check valves between the town mains and the mill fire protection system the fire pump supplied the community. This pump had been previously equipped with a fire pump chlorinator as required by the regulations of the State Department of Health, who also advised boiling the water in the emergency. At Beacon, New York, a mill fire pump similarly equipped with chlorinator was employed during a public water shortage.

Engineering News-Record.

The Cherry River at Richwood, West Virginia, in July, 1930. The building at the right is a pulp mill, one of the town's three industries, all dependent upon water from the river, which had to stop operations until December.

In other cases secondary water supplies of industrial plants have failed, and automatic sprinkler systems normally having two good water supplies have depended solely upon the city mains. A typical case is reported from a Pennsylvania town, where the pond furnishing fire pump suction for a large industrial plant went dry and the only water for automatic sprinklers was from a limited public supply. Up to February first, no failure of automatic sprinklers to extinguish fire owing to a drought depleted water supply has been reported to the N.F.P.A. Department of Fire Record. This is presumably due to special vigilance of inspection authorities and plant managements in cases where water supplies for fire protection have been affected.

It has been impossible within the limits of this article to mention more than a very few of the cities and towns that have suffered water shortages. Serious water shortages have been reported from such widely separated places as North Pownal, Vermont, and Houston, Texas, and the cases cited in this article are typical of conditions over a large area. Some of the normally arid regions experienced unusually heavy rainfall during 1930, but in general the situation has been more or less serious through most of the territory east of the Rocky Mountains, and even with a resumption of normal rainfall the drought of the past year may be registered in depleted water supplies in many communities during the coming summer. The wisdom of the general policy of municipal authorities in providing large water reserves has been amply demonstrated, and the drought has greatly stimulated activities in enlarging water facilities designed to maintain ample water supplies for domestic service and for fire protection in the event of a repetition of the drought of 1930.

The New Zealand Earthquake and Fire.

Earthquakes in New Zealand are not unusual phenomena. To the people of this Dominion, minor earth-tremors are a familiar and not very alarming occurrence. Hitherto they have been attended by very little loss of life. The Murchison earthquake of 1929 on South Island affected a large area of comparatively desolate country. It did considerable damage to property and seriously disorganized communications, but despite the violence and extent of the upheaval, only 16 persons lost their lives. Had that region been more thickly populated, the death toll probably would have been heavy. Prior to 1929, in the 80 years between 1848 and 1928, the era of European settlement, the fatalities were only seven.

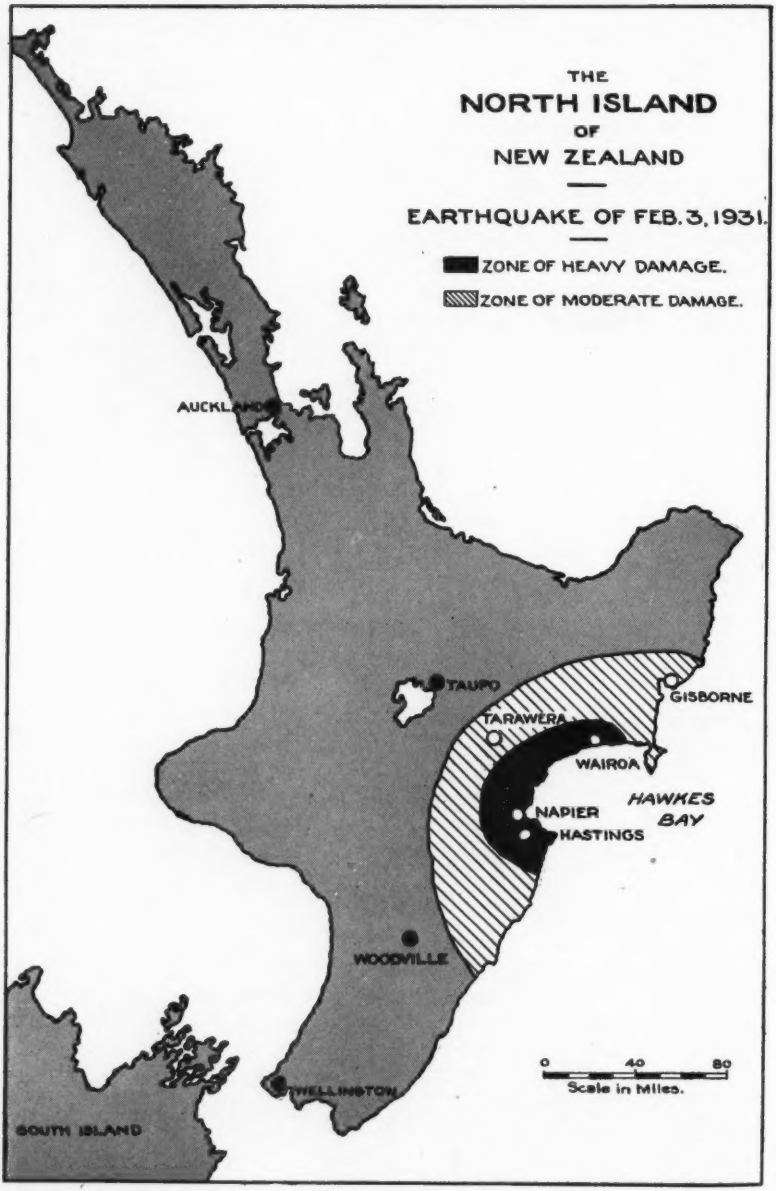
In spite of this apparent familiarity with earth-tremors, the people of New Zealand were little prepared for the disaster which occurred on February 3, 1931, when a severe earthquake leveled the thriving communities of Napier and Hastings and spread devastation over a wide area in the vicinity of Hawkes Bay on the East Coast of the North Island. More than 250 persons were killed and the number of injured was placed at 1600. The property damaged, first placed at about $15,000,000, is now estimated on good authority at more than $25,000,000.

It is interesting to note from records made by seismographs at the Dominion Observatory at Kelburn that 588 earthquake shocks originating in the Hawkes Bay district occurred from the time of the first big shock on February 3 until the end of the month. During the twenty-four hours following the initial disturbance tremors were very frequent, reaching a total of 151 for the day.

Description of District.

New Zealand is a British Dominion in the South Seas, situated approximately 1280 miles southeast of Australia. Geographically it consists of two main islands and a number of lesser insular groups. North Island is of irregular shape, approximately 475 miles long and varying in width from about 50 to 250 miles. South Island is more regular in shape and is approximately 500 miles long, with an average width of 150 miles. The two largest cities of the Dominion, Auckland and Wellington, are at the north and south ends respectively of North Island. Christchurch and Dunedin are the principal cities of South Island.

This report has been made possible through the courtesy of Thomas M. Marriott (Member N.F.P.A.) and R. Fox (Member N.F.P.A.), of New Zealand, who have furnished data, newspapers and photographs of the Hawkes Bay disaster. Acknowledgment is also made to the Auckland *Weekly Post*, *The Dominion* and the Wellington *Evening Post* for data extracted from their columns.—Ed.


THE
NORTH ISLAND
OF
NEW ZEALAND
EARTHQUAKE OF FEB. 3, 1931.
ZONE OF HEAVY DAMAGE.
ZONE OF MODERATE DAMAGE.
AUCKLAND
TAUPO
GISBORNE
TARAWERA
WAIROA
HAWKES
BAY
NAPIER
HASTINGS
WOODVILLE
WELLINGTON
SOUTH ISLAND
0 40 80
Scale in Miles.

New Zealand Gov't Photo.

View of Napier before the earthquake. Buildings in the mercantile area were for the most part of brick or frame construction with wood or iron roofs, easy prey for the earthquake and the fire which followed.

The Hawkes Bay District, where the February earthquake occurred, is a wealthy pastoral area on the east coast of North Island. It is a Province producing fine fruits and on its pastures graze nearly five million sheep. The principal municipalities of the Province are Napier, a city of 19,060 people, and Hastings, a town of 15,500. Port Ahuriri (port of Napier) is an important port for the export of frozen meat, wool and other products of agricultural nature and origin. Napier and Hastings are about 12 miles apart.

It was in these municipalities that the greatest damage resulted from eathquake and fire. For the most part, the data in this report refer to these communities rather than to the province as a whole. The accompanying map indicates the total area affected.

Water Supply.

The water supply of Napier was obtained from artesian wells, accumulated in surface storage tanks and pumped by electric pumps to elevated storage reservoirs. The distribution system was by gravity through cast iron mains varying in size from 12-inch to 3-inch and buried on an average of three feet under the road surface. In the business area the mains were mostly 6-inch and 4-inch in diameter, affording a pressure of 65 to 100 lbs.

Similar conditions relative to water supply were to be found at Hastings. The water was obtained from artesian wells and pumped by a number of Diesel engine driven pumps to two elevated reservoirs. Six-inch and 4-inch mains ran throughout the town, fed by a 12-inch main supplied by the two reservoirs. A pressure of 125 to 180 pounds was maintained.

Fire Protection.

The Napier Fire Brigade consisted of five paid men and thirty-two volunteers. It was equipped with three automobile pumpers, one first-aid truck, and two hose reels, which were housed in three stations. The city was provided with duplex street fire alarm stations.

The fire brigade of Hastings consisted entirely of volunteers, except the Chief. The manual strength of the brigade was twenty-two and the equipment consisted of two first-aid trucks and a hose reel. It was housed in a single fire station. Like Napier the town was fully equipped with a system of street fire alarms.

Building Construction.

In both Napier and Hastings building construction was, for the most part, of poor quality brickwork with wooden floors and wood and iron roofs. There were a large number of wooden buildings. A number of protected steel frame and reinforced concrete buildings of superior design and materials had been erected in both towns. These latter structures withstood the earthquake shock very well, but through lack of window protections interiors and contents were seriously damaged in some cases.

The Earthquake and Fires.

It was summer time in New Zealand and the morning of Tuesday, February 3, dawned still and oppressive along the East Coast region of the North Island. In the communities of Napier and Hastings, by mid-morning, shops and offices were full of people going about their daily affairs. It was exactly 10:48 A.M. (as indicated by the clock on Napier Post Office) when the earthquake struck these communities and, in a lesser degree, the whole of the Hawkes Bay region. There was apparently no premonitory creeping, no rumble or other warning, but just a tremendous upheaval that came like a flash and left behind it a trail of ruin and desolation within a few seconds. The initial shock is said to have been of less than a minute's duration.

Whole streets of business buildings in these two towns, apparently of substantial construction, collapsed. Walls crumbled into masses of débris and roofs fell in. The air resounded with the roar of falling masonry and was filled with clouds of dust. People rushed to the streets to avoid being trapped in buildings, only to be buried by the crumbling walls as they toppled into the highways. Others were trapped within, and if not crushed, perished in the fires which followed.

Napier.

At Napier, when people recovered from the first shock, they were horrified to see the hills behind the town crumbling away in clouds of dust. Great sections of the Bluff, a high prominence along the shore front, dropped away, burying the highway at its base. Tons of earth covered this road and it may be a long time before it can again be used.

E. T. Robson.

A portion of Napier's business district after the earthquake and fire. In the middle distance is the building of Dalgety and Company, Ltd., and at the extreme right the Public Trust Offices, both of which were but little damaged.

The shock was most intensely felt from the Marine Parade (along the seashore) toward the land. In the first quarter mile from the water front, probably because there were the largest buildings, the damage was the most severe. In the residential sections farther back the damage was less apparent and there are homes with only the chimneys down and little internal damage. The entire business area was reduced to ruins. Streets were blocked with wrecked motor cars, fallen wires, broken masonry and other débris. Within an area half a mile square the city was entirely devastated. What was not destroyed by the earthquake was reduced to ashes by the fire that followed.

The first fire occurred shortly after the initial quake in a chemist's shop (drug store), due presumably to an explosion of chemicals. The fire brigade managed to get the fire under control, as the pressure in the mains held for some time. They were, however, considerably handicapped by the fact that most fire plugs were buried in débris from fallen buildings. Just as they were getting this fire well in hand a similar outbreak occurred at another chemist's shop some distance away. This shop was located at the rear of the Masonic Hotel to the ruins of which the fire quickly communicated.

It was fully expected that these two fires would be confined to the areas in which they started, but just before twelve o'clock the calmness which had prevailed gave way to a brisk breeze from the sea, which swept the fires toward the business section of the city. Within a few minutes the flames reached conflagration proportions and were sweeping through the area already razed by the earthquake making terrific headway among the ruins.

Modern well-built structures of reinforced concrete withstood the earthquake well, as is evidenced by the department store of Dalgety and Company, Ltd. (left) and the Public Trust Building (right).

To add to the difficulties the water supply gave out and it soon became evident that the Fire Brigade was fighting against hopeless odds. A fire brigade pumper took suction at the salt water baths and for a time a hose line was supplied from this source. The wind continued to increase in velocity and in spite of all the firemen could do the fire swept onward until it reached Clive Square, where it was halted by the extensive open space.

Most of the buildings destroyed had exterior walls of brick or were of inferior reinforced concrete construction. Modern well-built structures of reinforced concrete withstood the earthquake well, as is evidenced by the Public Trust Building, Dalgety's and the General Post Office. The latter building was severely damaged by the fire, however, which entered it by way of unprotected window openings. At least 150 buildings were completely destroyed or severely damaged.

Relief work was quickly organized. Those only slightly injured or uninjured bent their efforts toward helping those whose condition was less favorable. Naval brigades from the warship *H. M. S. Veronica,* which was tied up at the wharf at Port Ahuriri, rendered all assistance possible. The crew from this ship were later assisted by the crews of *H. M. S. Dunedin* and *H. M. S. Diomede,* which were dispatched from Auckland when news of the disaster was broadcasted. These naval units, the Fire Brigade, doctors and nurses did yeoman service in caring for the injured, in clearing away the débris, and in recovering the bodies of the dead buried in the still smoking ruins.

One of the largest losses of life occurred at the Public Hospital, a fine group of buildings situated on an eminence behind the city. The hospital itself was partially demolished and the nurses home, a comparatively new

The new Post Office at Napier was of steel and concrete construction. This structure was little damaged by the earthquake, but was gutted by fire which entered through unprotected window openings.

three-story structure of brick and reinforced concrete, collapsed. It is said that some nineteen persons were in the buildings, of whom at least six were extricated alive from the débris, more or less severely injured. Eight bodies have been recovered and others are thought to be buried under the mass of bricks and masonry.

Another large loss of life occurred at the Technical College, an old brick building. When the first shock came, the children rushed out into the open. It is said that some of the older boys realized that some of the children were still in the building and regardless of the risk, rushed back inside the swaying walls. Before they could rescue their comrades, however, the building collapsed. Fourteen are known to have perished here.

Perhaps the most tragic incident took place in St. John's Anglican Cathedral. When the first shock occurred, Communion Service was being conducted. Almost without warning the walls caved in and although most of the congregation were able to escape, several were trapped, among them the Dean, who was rescued, but severely injured. An elderly lady was pinned beneath a fallen girder, but was not killed. Rescuers immediately noticed her plight, but all efforts to lift the huge girder were unavailing. Then the flames broke out and gradually drew nearer and nearer to the stricken woman. Hose streams were used, but in a few minutes the water supply failed. Finally it was realized that she had no hope of escape and in order to save her from a frightful death by burning a doctor administered a large dose of morphine. Death was inevitable, but at least it was without pain.

The Masonic Hotel was the leading hostelry of the city. It was a large structure with brick and stone walls situated on the Marine Parade adjacent

Technical College, Napier. Fourteen boys are known to have lost their lives when the walls of this old brick structure collapsed.

to the principal business district. It was feared that the loss of life in this building had been heavy and crews were soon at work with tractors and steel cables, picks, shovels and crowbars. About fifty tons of fallen brick and masonry were removed from where once had been the entrance to the hotel. Underneath were discovered seven bodies pathetically huddled together and some of them mangled beyond description. Obviously they had rushed together to escape from the building, but had been caught just as safety seemed certain. The Empire Hotel presented a peculiar aspect after the quake. The brick walls fell away, leaving the wooden partitions in place, which kept the building from collapsing. The bedrooms with their contents stood intact. This building was beyond the fire zone.

Dr. Moore's private hospital on the shore front, a three-story structure of brick with stucco finish was broken at the foundation and took a backward cant of five to ten degrees, but did not topple over. This was one of several comparatively new buildings that had been erected under the lee of the Bluff, practically all of which are now only tottering walls. The whole of the interior was a mass of fallen masonry, roof tiles and wrecked furniture. Fortunately no lives were lost, but a number of patients and employees were rescued by prisoners from the jail near by.

The large gasoline tanks at the bulk storage station remained intact and, although exposed, did not take fire. This enabled the petroleum company to give uninterrupted service throughout the disaster, greatly facilitating the maintenance of relief services. The brickwork of some of the subsidiary properties was damaged and the roof of a store containing cased gasoline in tins fell in, but no fire resulted. Some of the tanks were said to have been somewhat damaged and out of plumb. Filling stations with underground tanks, while exposed, did not take fire.

With the destruction of Government offices, banks, stores and other offices, considerable confusion will exist for some time. Every title to land in the district from Wairoa to Woodville was burned when the Lands and Deeds

Starting in a chemist's shop, the fire driven before a brisk wind swept through the business area of Napier already razed by the earthquake.

Registry and Lands Survey Office were destroyed. The Lands and Deeds Office was wrecked by the first shake, but the employees returned and closed the steel doors and left the building, believing the records safe within. Then came the fire, which swept the building in which were stacked documents, plans, and records embracing the private land records of the whole Hawkes Bay Province extending back to 1848. Similar conditions prevailed in other offices and one legal office alone lost securities covering £3,500,000. The books and cash of the National Bank were reported to be safe, but one of the other banks lost most of its books and records.

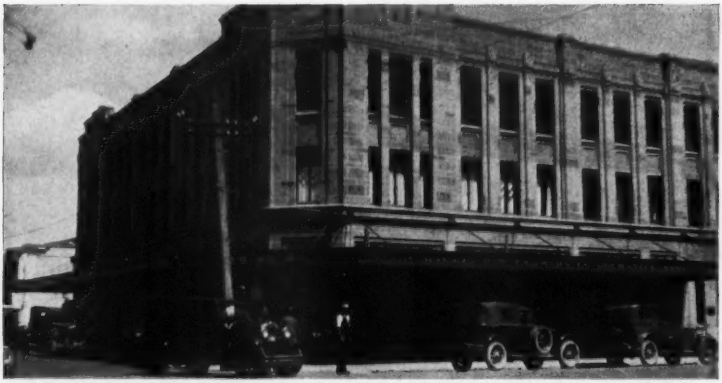
Port Ahuriri.

The sensation experienced when the earthquake struck the water front was that of a terrific upthrust from below, which lifted boats to the level of the wharves and overturned the Harbour Board's sheds. The wharves, all the way along, were cracked and out of plumb and sunk in places. Railroad tracks were bent and twisted out of shape.

A fire started in the upstairs portion of Robjohns, Hindmarsh and Company's two-story building at Port Ahuriri. The front and side had fallen out, and the wreck was soon a blazing furnace. The fire spread rapidly and consumed all in its path. All wholesale premises were destroyed, besides several wool stores, the Post Office, and other buildings. Next morning the wind was blowing in the opposite direction, fanning the flames into renewed activity, and placing the residential portion in grave danger. Fortunately, however, the fire was brought under control without spreading further.

Hastings.

In Hastings the business area suffered almost equally with that of Napier. The town was full of shoppers when the disaster occurred and they were



The Hawkes Bay Farmers' Co-operative Association Building at Hastings. Built of "mushroom" type reinforced concrete construction, it withstood the shock so well that not even a window pane was cracked.

caught without warning. Many motor cars were buried as they stood beside the curb, and in several instances the occupants were trapped in them. With the exception of three or four buildings of reinforced concrete every commercial building in the town was either razed to the ground or damaged to such an extent that complete rebuilding will be necessary.

Heretaunga Street, the main thoroughfare, was transformed into a highway of destruction beneath whose ruins could be heard the cries of women and children. The destruction was complete. The centers of all streets were littered within a few moments with a tangled mass of telephone and electric light wires, veranda poles, great masses of concrete, and furniture hurled from shops and offices.

The upheaval had come without warning. Dozens who had rushed out of buildings were buried beneath bricks and mortar as soon as they gained the sidewalks. Even had they remained inside there would have been no escape. The staffs of drapery and other stores were crushed beneath the whole weight of buildings as they stood at the counters, and those they were serving shared a like fate.

The escapes were remarkable. Some people were thrown into the street to get up and walk away almost unhurt. Those who had escaped tore frantically at the piles of débris covering people who had been standing near them when the shock occurred. Rescues were made in many instances with the débris falling on every side.

Conspicuous among the ruins was the Hawkes Bay Farmers' Co-operative Association's new building, which was first occupied about two months previous to the earthquake. It was of "mushroom" type reinforced concrete construction and so well did it withstand the shocks that not even a window pane was cracked, although the buildings on all sides of it tumbled to pieces.

Ruins of the fire station at Hastings, which collapsed during the earthquake. Fortunately the brigade was able to get the apparatus out.

Wooden buildings also appeared to have fared well, and it was particularly noticeable that the Albert and Carlton Hotels stood safe and uncracked to all outward appearances.

As in Napier the earthquake was followed by fire, although at Hastings the fire damage was not as serious. The fires were nearly all kept in hand by the fire brigade. The pumping station was not damaged and it was possible to pump water direct from the artesian wells, maintaining a pressure of 150 lbs. in the mains, for more than an hour after the 12-inch main from the reservoir had fractured. It is considered that the maintenance of this water supply was of material assistance in controlling such fires as broke out immediately after the first shock.

The principal fire broke out during the night following the earthquake. It originated in the ruins of the Grand Hotel and a light breeze and inadequate water supplies permitted its spread to adjoining buildings, an entire block being destroyed. The Union and National Banks, which survived the earthquake, were completely gutted.

The principal loss of life in Hastings is thought to have occurred in the Roach Store and in the Public Library, both of which were full of people at the time of the first shock. Fifty persons were said to have been on the top floor of Roach's, a department store of brick construction, four stories in height. The roof of this building was almost flat with the ground, supported only by a great pile of bricks which once went to make up its walls. A similar condition prevailed at the Library. Accurate data are not available as to the exact number of lives lost at these two locations.

In the residential section not one erect chimney was to be seen, and in many cases the falling chimneys had gone through the roof. Many holes gaped in these wooden dwellings, but they stood. Nevertheless, the residents preferred to sleep outside after the disaster. There was always the fear that

doors and windows might jam—as happened in many instances, where occupants suffered agonies of fear before they could get out. Residents of Hastings pointed out that considerable extra damage had been done by a second major shock on Tuesday night, which, coming hours after the first terrific shock, completed its work on several large buildings. Hastings, unlike Napier, has no sea and no hill; its ruin was less spectacular for the latter reason.

Other Districts.

Northward from Napier on the road to Wairoa the whole contour of the country has changed. The outlet of the Waikare River was blocked by a huge slip in the ravine near its mouth. At one point an area of five acres disappeared into the river. Along parts of the road were huge fissures in the surface, some being as great as four feet in width.

At Mohaka, the Mohaka Hotel caught fire after the shock and was burned to the ground, while near Wairoa another house suffered a similar fate. Half the business portion of Wairoa was reduced to ruins and not more than six chimneys remained standing in the residential section. The meat works, the Gaiety Theatre, post office and other places were badly damaged, while numbers of small shops were razed. Several blocks of brick buildings along the river front were leveled.

On Thursday following the earthquake, fire was discovered in the cold storage plant at Wairoa. The fire brigade was rushed to the scene, but as power had been cut off since the quake on Tuesday, there was no means of pumping water. Within an hour the frame portion of the structure embracing the freezing chambers was destroyed and flames were threatening the brick portions. There were 35,000 carcasses in the building.

Between Napier and Taupo on the road to Auckland cracks and slips were frequent all the way from Napier to Tarawera. At the latter place the hotel suffered badly and its walls and contents were in a chaotic state. At Te Pohue also, the hotel was considerably damaged. At Taradale the clock tower had listed to a steep angle. The clock had stopped at 11:47 A.M. Near by, an artesian well flowed freely into the streets. The Taradale Hotel was badly damaged. The Town Hall and the theatre were flat. Several brick residences had suffered a similar fate and a few wooden houses were broken in halves, disclosing chaos within. Huge fissures had opened up in the roads and some ran for a half a mile or so across the fields.

The approach and one span of the bridge near Port Ahuriri collapsed. Telegraph poles stood at rakish angles and huge fissures ran along the road like cracks in dry mud. Within a short distance of each other a gasoline truck, two cars, a truck loaded with soft drinks, and a bus were helplessly buried. Broken gas mains were visible deep down in the cracks and the nearby railway resembled a switchback. All the Roman Catholic Seminary buildings at Greenmeadows were destroyed with a loss of life of nine. The main

The railway paralleling the highway from Napier to Port Ahuriri was twisted and bent. The road bed was shifted several feet.

Road leading from Napier to Port Ahuriri, showing huge fissures several feet wide, which at points made the road practically impassable.

building was of frame construction and the chapel of brick. It is thought that those killed and injured were in the chapel at the time of its collapse.

Similar conditions prevailed in the smaller communities south of Napier and Hastings as far as Waipukuran. Hardly a chimney was standing in the entire area. Shop fronts were damaged and broken glass and bits of masonry littered the highways in front of the demolished shops. Te Aute College was irreparably damaged, particularly the modern brick building. In strange contrast with the weakened brick structures, the old wooden college church stood unscathed with its spire erect, looking down on the devastation.

The picturesque village of Havelock North presented a desolate scene. Hardly a shop was standing at any one of the corners of the six roads that meet there. The ivy-covered village church escaped practically without damage, but many of the beautiful homes in the district were almost razed to the ground. The large wooden bridge on the Hastings Road collapsed for about 50 yards of its length, and it lies, a broken twisted wreckage, in the old river-bed below. The 12-inch water main which crosses the river-bed on a high iron trestle at this point was fractured and bent into a wavy line.

Loss of Life and Property.

No official total of lives lost in the devastated area has been issued, but a careful check of the casualties as revealed by the lists published from day

This is a 12-inch cast iron main on the road from Hastings to Havelock, which broke when the bed of the river bank sank approximately 30 feet and the bridge collapsed. The woodwork under the main shown in the picture has been put in since the earthquake.

to day shows the figures to Friday evening, February 6, to be approximately as follows:

Napier	119
Hastings	95
Other Districts	17
Total	231

This list is probably not complete, for at the time of its compilation all returns were not in.

At the moment it is impossible to ascertain the actual amount of damage done to the several towns, but local authorities feel that it will exceed $25,000,000. Due to the present trade depression, which has caused the value of produce to drop materially, and with thousands of people out of employment, the matter of reconstruction and rehabilitation presents a serious problem from a financial standpoint.

Damage to Industrial Plants.

The information concerning the state of the refrigeration plants in the Hawkes Bay District is not yet complete enough to form an estimate as to the loss likely to be sustained by the various companies. If the damage to the plants was serious the effect on the industry will be considerable, as the killing of stock for export was about at the peak. The three freezing works in the vicinity of Napier and Hastings had in store an estimated total of about 250,000 carcasses, and it was hoped to save this valuable stock by railing it to Wellington for shipment.

Messrs. Borthwick's works at Pakipaki, about four miles south of Hastings, according to the advice available, were practically a complete wreck, with the exception that the insulation of the freezing chambers held, and it was hoped it would be possible to ship this meat out by rail.

It was feared that heavy damage was done to the Tomoana freezing works of Messrs. Nelson, Limited. While the freezing chambers were badly damaged, it will be possible to save the meat by keeping the temperature at the correct level. Only heavy rain or delay in shipping will cause the loss of this meat.

It is believed that the Farmers' Co-operative freezing works at Whakatu are not damaged to the same extent as the other plants, but great anxiety is felt that the loss of freezing power might endanger the meat in the chambers.

Damage to Water Works.

The two reinforced concrete reservoirs situated on Bluff Hill north of the city of Napier stood the shock very well. The smaller of the two had a small crack across the center and up both sides, but retained a good deal of water. The larger reservoir was divided into four compartments, two of which were damaged. The other two held water satisfactorily.

At the large reservoir a steel tank had been erected on a 40-foot steel framework to give additional pressure in the city mains. The concrete foundation withstood the shock, but the upright steel members sheared off at the holding plates attached to the foundation. A similar 40-foot steel structure at the Napier Public Hospital supporting four iron tanks about 4 feet in diameter and 6 feet high withstood the main shock satisfactorily, but a later shock dislodged one of the tanks.

Most of the mains were cast iron and with very few exceptions the fractures were found to be dislocated joints at the sockets. At Hastings the water supply was not affected until the large 12-inch main fractured where it crossed the bridge on the road to Havelock. The bridge went down and when the main broke it virtually drained the reservoir and no water was available in the town.

The Insurance Situation.

Insurance policies upon properties in New Zealand do not cover loss by reason of earthquake unless specially provided for. Therefore, except to those policyholders who were specifically insured against loss due to earthquake, no payments can be made in respect to losses arising out of the Hawkes Bay disaster. At the same time the Prime Minister announced that the Government had decided that the State Fire Office would make *ex gratia* payments, at the discretion of the General Manager, to policy holders whose insured property had suffered damage. Payments, however, are not to exceed in any case the amount of fire damage and will not under any circumstances extend to purely earthquake damage. This decision instigated a very considerable controversy as to the use of State funds.

In the past very little earthquake insurance had been taken out in New Zealand. Just after the 1929 earthquake at Murchison the public became interested in this form of coverage, but afterwards the matter was practically

Tennyson Street, Napier's leading business thoroughfare, showing devastation wrought by earthquake and fire.

forgotten by the majority of property owners on both islands. The recent disaster has again brought the matter to their minds and there has been a great rush by the general public to insure against earthquake loss.

Conclusions.

Buildings of all types suffered, even those of superior design and construction. It is significant, however, that in those buildings of superior construction, the damage was reduced to a minimum, and the repairs to be effected to make them usable will be negligible.

In residential districts the frame house, always looked upon in New Zealand as a harbor of safety in time of earthquake, was apparently viewed with mistrust by the public, even after the chimneys had been shaken to the ground. This is supported by the fact that in the days immediately following the initial shock all Napier residents preferred to sleep upon their lawns or their neighbor's lawns rather than in the security afforded by timber dwellings.

Almost without fail the chimneys came down in the residential districts of both Napier and Hastings, and throughout the affected area, sometimes resting almost intact on the roofing and sometimes in smaller units on the ground or on the roofs. In almost every case these chimneys were in poor condition to withstand an earthquake shock, the walls being but $4\frac{1}{2}$ in. thick and aged and weathered beyond the point of resistance. Insufficient clearance round the chimneys was, in conjunction with the above, almost invariably the cause of failure, the difference in periodicities of vibration between the greater and lesser masses (house and chimney) bringing about collision and damage.

There was a certain type of collapse that might be called "pancaking." The walls (mostly brick) simply crumbled and the roof (more or less intact)

rested on the pile of resultant débris, not very far from the ground. Abundant samples of various kinds of "pancaking" are evident both in Napier and Hastings. There was hardly a public garage left in Hastings. It seems that the public garages consisted mainly of widely separated brick walls (to give interior floor space) and a long span of roof. The walls fell, and the iron roofs collapsed on top of the débris.

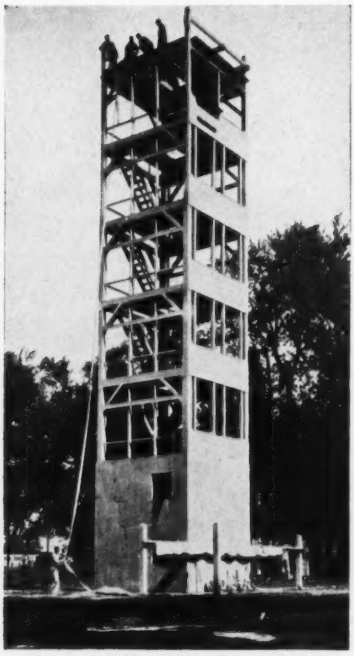
The problem of rebuilding and rehabilitation presents many difficulties. The evidence presented by buildings still standing, in which people would have been safer than on the streets, would seem to indicate that the enactment and enforcement of an adequate building code would give an assurance of public safety greater than that which has existed in the past.

Fire Department Drill Towers.

Efficient fire fighting demands regular and systematic drills and training for firemen, whether the community be large or small or the fire department composed of paid or volunteer members. Not only does this apply to new recruits or "rookies" who require instruction in the rudiments of fire fighting, but it is equally essential to maintain efficient operation of individual companies, particularly those comprising small city or town fire departments and light duty companies in a large city. Heavy duty companies are kept in trim and practice by constant fire duty, but let them remain inactive for a short time with little or no training and their operations at the next large fire will reflect this inactivity.

The increase of interest in greater efficiency in fire fighting and in better instruction for firemen, both in city fire departments and through firemen's short courses in various states, has brought about a demand for adequate facilities for such instruction. The principal feature around which such training courses must center, whether they be municipal drill schools or state courses, is the drill tower. It is almost indispensable in instructing men in hose and ladder work, and the fire department which has been provided with such a tower, and makes good use of it, should be a long step ahead of those not so equipped.

In details of style and construction there are almost as many different types of drill towers as there are cities and towns that own them. They vary in area, height and shape from the open tower of heavy timber construction having a ground area of 10 to 12 feet and approximately 50 feet high, to the colossal enclosed tower of the Detroit Fire Department, large enough, not only to contain an 85-foot aerial truck, but to permit the "big stick" on that truck to be raised and used in drill evolutions inside the tower.

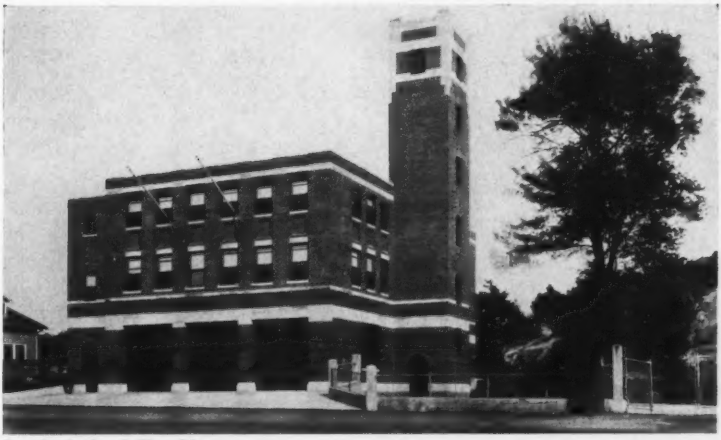


Typical drill tower of heavy timber construction used by the Hartford, Conn., Fire Department. Note side boarded-in for pompier ladder work and life net for safety of firemen.

A drill tower of brick construction used by the Washington, D. C., Fire Department. A fire escape is provided and a smoke house is included on the first floor of the tower.

The type of tower most commonly found is the open tower of heavy timber construction. These towers are usually approximately twelve feet square and fifty feet or five stories in height. This height provides five landings on which to work. The foundation of the tower may be of reinforced concrete with reinforced piers to which the upright members are attached. One side of the tower should be boarded in and provided with windows to facilitate pompier and other ladder drills. Stairs equipped with railings should extend from floor to floor. These are preferable to steep steps or ladders, for they make for safety and also provide opportunity for practice in running hose lines up stairways. For purposes of drills with cellar pipes a hole may be cut in the floor of the first platform, although many departments prefer a portable platform for this purpose.

The cost of this type of tower is difficult to determine definitely. It will vary by localities and much depends on whether it is built by outside concerns, city employees or the firemen themselves. A tower of this sort was erected at



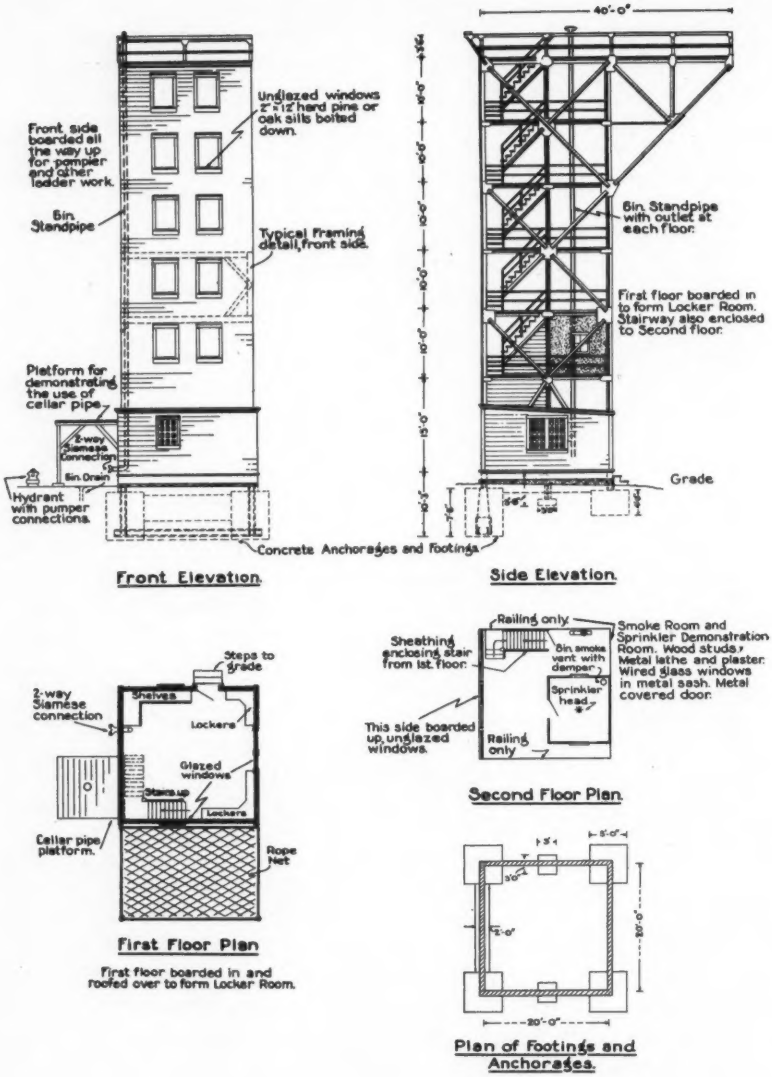
Fay, Spofford and Thorndike.

Chestnut Hill Avenue Fire Station at Boston, showing the tower constructed especially for drill purposes. The rear of this tower (not shown in the picture) is provided with a fire escape.

Fort Dodge, Iowa, about five years ago, provided with a smoke room, sprinkler system with an outside connection and exterior iron ladder to standpipe. Its total cost was not in excess of $2000. A similar tower containing a fire-resistive smoke room on the first floor, completely boarded-in on all sides and equipped with windows and doors on each floor, was erected in Stamford, Conn., a few years ago by members of the fire department at a cost of approximately $1200. Contractors bidding on the job gave $2700 as their lowest bid.

Some of the larger cities in the last few years have constructed drill towers of much more elaborate design and of brick and cement. Towers of this type are in use in San Francisco, Cal., Washington, D. C., and Providence, R. I. A tower similar to that of Providence or Washington is said to cost in the vicinity of $16,000. These towers are equipped with standpipes, sprinkler systems and fire escapes in order to simulate any and all conditions which might be found in a large city. Where brick or concrete construction is used, wooden window sills are essential to permit drills with pompier ladders.

Many cities prefer to incorporate their drill tower with a hose tower on a fire station. This can be very satisfactorily accomplished where there is sufficient room adjacent to the fire station to do efficient drill work. There must be room to handle all ladders from an 85-foot aerial ladder (if the department has one) to the shortest roof ladder. It must also be possible to maneuver a pumper and operate hose lines without undue confusion. Inside arrangements of the tower can be constructed so as to provide room to hang hose up to dry without interfering with the utility of the tower for drill purposes.


Front side boarded all the way up for pompier and other ladder work.
Unglazed windows 2" x 12" hard pine or oak sills bolted down.
6in. Standpipe
Typical framing detail, front side.
Platform for demonstrating the use of cellar pipe.
2-way Siamese connection
6in. Drain
Hydrant with pumper connections.
Concrete Anchorages and Footings
Front Elevation.
40'-0"
6in. Standpipe with outlet at each floor.
First floor boarded in to form Locker Room. Stairway also enclosed to Second floor.
Grade
Side Elevation.
Steps to grade
2-way Siamese connection
Shelves
Lockers
Glazed windows
Stairs up
Lockers
Cellar pipe platform.
Rope Net
First Floor Plan
First floor boarded in and roofed over to form Locker Room.
Railing only
Sheathing enclosing stair from 1st. floor.
Smoke Room and Sprinkler Demonstration Room. Wood studs, Metal lathe and plaster. Wired glass windows in metal sash. Metal covered door.
6in. smoke vent with damper
Sprinkler head
This side boarded up, unglazed windows.
Railing only
Second Floor Plan.
5'-0"
3'-0"
20'-0"
20'-0"
Plan of Footings and Anchorages.

Fire Department Drill Tower.

Diagrams drawn from plans of a tower suitable for average Fire Department conditions as recommended by The National Board of Fire Underwriters.

A tower of this type is attached to the new fire station erected on Chestnut Hill Avenue in the Brighton section of Boston. The tower is six stories high. Steel stairs with wrought iron railings extend from the bottom floor to the sixth floor. The stairs have some winding stair treads to simulate conditions in old apartment houses and other buildings where the fire department may have to work over winding stairs. A 4-in. galvanized wrought iron pipe with two outlets on each floor of the tower and with a pumper connection at the first floor serves as a standpipe, which is used by the firemen in practicing laying hose from such equipment at various floors. A fire escape ladder with balconies is provided for drill purposes. This consists of a fire escape balcony on each floor with a continuous wrought iron ladder from the ground to the roof. The cost of this tower was not separately figured, but based on the unit costs of the building its cost was approximately $10,000. A tower separate from the building, if constructed similarly, would probably cost considerably more.

The National Board of Fire Underwriters has developed plans for a drill tower for fire department use, which consists of a steel frame with wood platforms or floors. It is boarded-in on one side and is 7 stories or approximately 70 feet in height. The ground area is 20 x 20, but the 7th or top floor is extended to make a platform 20 x 40. This is accomplished by extending the steel framework at the 5th floor level to form a bracket supporting the platform on one side. The tower is provided with a locker room on the ground floor and a smoke and sprinkler room at the second floor level. A tower of this type has been in use by the Indianapolis fire department for some years.

The first city to employ an inside drill tower in the United States was Chicago. In 1928 a tower was completed which permitted the raising of 65-foot extension ladders as well as pompier ladder drills inside the building. This first project has been followed and improved upon by the Detroit Fire Department, who have recently opened what is probably the largest and most complete drill tower in the world.

The Detroit Fire Department drill school occupies four acres of land upon which stands a brick, steel-frame structure of six stories, 78 feet high and 100 x 125 feet in area. The building is so arranged that any drill or evolution undertaken outside in good weather can be repeated inside when it is inclement. This includes drills with aerial ladder trucks, pompier ladders or pumpers and rescue work with life nets.

The building, in addition to the tower, contains classrooms and laboratories, and the fire college classes are held here. Every device and all equipment known in fire fighting are a part of the school. Fire escapes identical with those used by hotels, office buildings and factories and low-pressure and high-pressure hydrants are included in the structure to familiarize firemen with their problems when fighting downtown blazes.

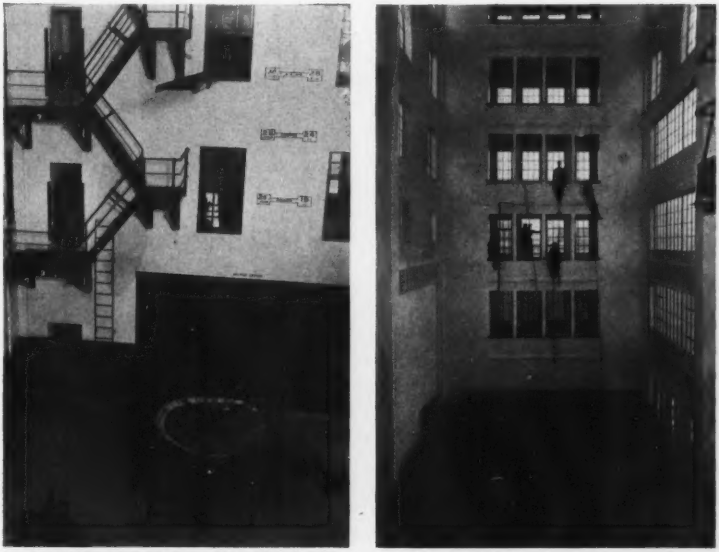
Detroit Fire Department.

Interior of the Detroit drill tower, showing aerial ladder extended. Note instructions on walls as to proper size ladders for various heights. The fire escape shown is the duplicate of one on the outside of the building.

A typical revolving door affords entrance to the west side "experimental laboratory," and here probationary and veteran fighters practice the "breaking" of the blades of the door to permit mass exit from buildings.

The smoke room, where firemen learn to battle flames with gas masks, and which is equipped with automatic sprinklers, has walls of glass. This affords the student an opportunity to record the time, action, characteristics and results of burning of rubber, wood, paints, varnishes, chemicals, oils, tar, pitch and other commodities which give off acrid smoke and gases. The chamber also contains a fan, which clears the atmosphere quickly and saves time between tests.

There are two items of auxiliary equipment in connection with the drill tower which should always be included, the smoke room and the safety net. The purpose of the smoke room, as indicated in the preceding discussion, is to familiarize the men with conditions which may prevail at any fire and teach them the proper use of gas masks. The safety net is to guard the safety of "rookies" and others when working or drilling at the tower. This net should be supported by removable posts and springs attached to the side of the tower. It should extend the entire width of the side to which it is attached and extend out from the tower a sufficient distance to preclude the possibility of anyone falling beyond the edge.



Detroit Fire Department.

The Detroit drill tower. At the left, a life net drill, showing man landing in net after a 30-foot leap from a window above. At the right, pompier ladder drill in one of the bays of the tower. Note permanent landing net to assure safety to recruits in event of accident or ladder fright.

Record Protection and Office Equipment.

By S. H. Ingberg,*
Chairman, N.F.P.A. Committee on Protection of Records.

After fires involving records, the relative merits of the different kinds of containers from the fire protection standpoint are frequently discussed in the reports on the fires and by others examining the ruins. Examinations of buildings, after fires that have partly consumed the contents, reveal such great difference in fire severity between different portions of the building and even different portions of an affected room, that it is most difficult to draw conclusions even in a comparative sense as to the protection afforded by the various record containers involved. To this is generally added the further variation in fire exposure produced by extinguishment at various stages of the fire.

The following observations are based on considerations of the general structural and fire hazard conditions applying to record protection and on results of some fire severity tests with office occupancy and records storage. While these tests were conducted mainly to obtain information on the severity of fires that can arise with given amounts of combustible room contents, considerable information was developed on the protection afforded the contents by various types of record containers. A considerable number of furnace tests of uninsulated and insulated filing cabinets and insulated safes have also been made.

Any protection afforded by uninsulated metal containers, such as metal filing cabinets and shelving, can be stated to be obtainable mainly when such furniture is used almost exclusively within a given fire area, taken together with a fire resistance of the building in which the occupancy is housed sufficient to enable its interior and exterior construction to maintain its integrity without collapse in a fire consuming the combustible contents in some or all portions thereof. Thus a few metal filing cabinets distributed among a greater number of wood filing cabinets, wood furniture and other combustible contents cannot be regarded as affording any measurable degree of protection to their contents. If the other combustibles present sustain a fire of even mild severity, the contents of the metal files will be consumed even though the latter contribute nothing to the origin and spread of the fire and only in a minor degree to its severity. In non-fire-resistive buildings, fires starting in or com-

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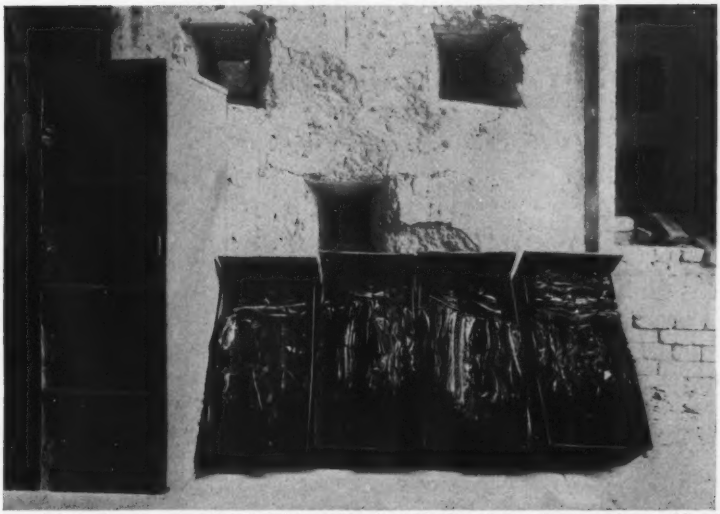
*Chief of the Fire Resistance Section, U. S. Bureau of Standards.

This article is based upon a paper presented before the October, 1930, meeting of the Federal Fire Council, an organization of U. S. Government representatives concerned with fire prevention and protection. Its publication in the QUARTERLY has been approved by the Director of the Bureau of Standards of the U. S. Department of Commerce.



Contents of uninsulated filing cabinet after 30-minute furnace test. About 20 per cent of area of tightly packed papers were consumed. Loosely packed papers were completely charred. The extinguishment of the fire in the drawers soon after the fire exposure prevented greater damage to the contents.

municated to any portion of the building can cause collapse and complete destruction of combustible contents, hence in this type of structure no great degree of effectiveness can be assigned to uninsulated record containers.

Furnace Test of Uninsulated Filing Cabinet.

Perhaps the best information we have on the protection afforded was obtained from a furnace test with an uninsulated metal filing cabinet and from some fire severity tests in which a few of these cabinets were included among the wood furniture and combustible contents. The four-drawer metal file subjected to the furnace test was of the usual design with single No. 18 gauge top, bottom and back and with finish side sheets flanged to form a 1½-inch air space with the inner side sheets. The drawer fronts were also of double metal, formed to give one-half inch air space.

The file loaded with 135 pounds of paper, most of it packed tightly in the drawers, was subjected to fire exposure on all sides in a gas-fired furnace. The temperature rise within the furnace was regulated to conform as nearly as possible with that of the standard furnace test, reaching a maximum indicated furnace temperature near 843°C (1550°F) at 30 minutes, when the firing was discontinued. The drawers were opened and quenched with water 5 to 10 minutes later. The outer portions of the papers in all drawers were

burnt or charred for ½ to 1½ inches from the surface where tightly packed. This left an unconsumed area of about 80 per cent of the total sheet and between 90 and 95 per cent of the space written upon. Loose papers were charred over the whole area. The loss in weight of the paper in the file was 20 per cent. Temperatures at points within the drawers were high enough to cause ignition of paper five minutes after the start of the fire and at nine minutes flames issued from the front of the file.

Test of Occupancies with Wood Furniture and Shelving.

In the fire severity tests, one-story brick and concrete buildings, one 15 by 29 feet and the other 30 by 60 feet in inside dimensions, were fitted with desks, files and shelving that with their content of records gave a combustible content averaging in different tests, 10 to 55.4 pounds per square foot of floor area. The heavier concentrations were from records on closely spaced wood shelving. In the tests in which metal files were included the combustible content, inclusive of wood top floors when present, did not exceed 15.4 pounds per square foot and the papers in the metal files did not constitute over 5 per cent of the combustibles in the room. The fires consumed all combustibles within the room with the exception of portions of floor sleepers and contents of insulated safes. The fires were equivalent in severity to a little over the first hour of the standard furnace test. The contents of the metal files were completely charred and portions were reduced to ashes. The writing on portions of the charred sheets could be deciphered because of the lighter color of the char under the typewritten or printed characters. The experience in these tests, as well as examination of record containers after fires in buildings, indicates the desirability of extinguishing contents of file drawers without dumping of contents on account of greater possibility of salvage or reconstruction of the records.

Tests of Office Occupancy with Metal Furniture.

The fire severity tests with occupancies in which metal furniture and shelving were used exclusively were undertaken mainly to determine the decrease in the severity of fire obtainable by this means. The results of the tests considered from this standpoint have been published.* From the standpoint of the protection afforded the contents of the containers as well as the room as a whole, the following account of test conditions and results may be of interest.

Test with Cement Finish Floor.

The building used for these tests was the smaller of the two previously mentioned. The furniture consisted of desks, tables, filing cabinets and shelves, being about the same in number and arrangement as those of wood

*Severity of Building Fires—by S. H. Ingberg—Proceedings Fourteenth Annual Meeting Building Officials Conference, 1928, p. 87; Safety Engineering, August-September, 1928; QUARTERLY, National Fire Protection Association, Vol. 22, No. 1, July, 1928, p. 43; The Architectural Forum, Vol. L, No. 5, May, 1929, pp. 775-782.

present in previous tests. The cement floor was without carpet or other combustible finish.

In the tests with office occupancy the amount of records was greater by about 25 per cent, and almost 50 per cent of it was placed on top of tables and desks or in open shelves or cabinets. There were rows of metal cabinets, tables and shelves of various designs along the walls. The central portion of the room was occupied by two metal desks and one table, together with four sheet metal waste paper baskets and two or three chairs.

The first fire was started in the contents of a large sheet metal waste paper basket in front of an open shelf about 9 feet high, the shelves being 5 to 10 inches apart and 3 feet long between partitions. The fire scorched the edges of the papers on the shelf, but did not start a sustained fire thereon and after 15 minutes the basket was taken out with about one-fourth of its contents consumed.

As the contents of the basket had been packed somewhat too tightly for best combustion, the contents were replaced with 10 pounds of more loosely packed paper and about 3 pounds additional were placed on the floor in contact with and in the lower portions of the open shelving. In this test the papers on portions of the two open shelves and on one table immediately adjacent to the fire origin were ignited, but the fire did not spread, and at one and one-fourth hours only faint flames and glowing of exposed papers were apparent. The highest room temperature reading was 104°C (219°F), which was at 35 minutes after start of fire, directly above the burning paper. The average indicated temperature in this end of the room was at this time 54°C (129°F). Only 150 pounds of exposed records were burnt or charred in whole or part.

The affected paper was replaced with unexposed stock and the exposure grate located in one corner of the room filled with 424 pounds of pine kindling saturated with one gallon of kerosene. The grate was 3 feet 2 inches in diameter and 6 feet 7 inches high, and was inclosed by a sheet metal shield, which was withdrawn when the kindling was fully ablaze. In the present test a high enough temperature was built up to cause ignition of exposed papers for a 20-foot distance along the center of the room and for 10 to 15 feet along the side walls. The temperature maximums at different points in the room occurred between 5 and 15 minutes after the blast of flame and hot gases was liberated, most of the heat developed being from the fuel in the grate.

At the end of this period the room temperatures were generally too low to cause ignition of combustible materials. During the initial period the temperature maximums in the end of the room where the fire started ranged from 146 to 808°C (295 to 1486°F) and in the opposite end from 55 to 542°C (131 to 1008°F). One-half hour after the exposure start the average room temperature was below 150°C (302°F) and the maximum indicated for any

Office occupancy with metal furniture on cement floor after exposure start.

point was 226°C (439°F), which latter was directly above the grate. At one hour the average was below 100°C (212°F) and the maximum 194°C (381°F).

The exposed papers and linoleum desk and table tops within 10 feet from the grate along the sides of the room and within 16 feet from the grate in the central portion of the room were consumed. Contents of closed file and desk drawers, where not affected by burning of exposed papers and linoleum immediately on top, and where more than 5 feet from the grate, exhibited practically full legibility. For the room as a whole, between two and three per cent of the records within closed containers were made illegible in the ordinary sense. Some of the charred papers classed as illegible could be read if carefully handled.

Tests with Wood Finish Floor.

All affected paper was replaced, as were also the burnt top coverings of tables and desks, and a ¾-inch pine top floor on 2 by 3-inch sleepers in dry cinder fill placed over the concrete floor. Furniture and contents were arranged as for previous tests, except that the amount of exposed paper was decreased by 400 pounds which, with other minor changes, gave a record content of 3,420 pounds and with the wood flooring a total combustible content of 11.9 pounds per square foot of floor area.

In the first test with the wood floor the fire was given a slow start in a pile of waste paper at the same point from which fire was started in previous tests. Fire was communicated to the papers on the adjacent large open shelving units and to the papers on top of the table supporting one of them. The progress of the flames was not rapid, over one hour being required for the

fire to spread to all parts of the large open shelf. The fire in the wood floor also spread slowly, about 30 per cent of the floor being consumed eight hours after the fire was started. The fire in the floor was stopped at this stage. No decided rise in room temperatures occurred, the maximum readings at the different points ranging from 50 to 230°C (122 to 446°F), the temperatures for only two locations being at any time high enough to ignite ordinary combustible materials.

The papers in drawers and on top of a desk and a table, beneath which the wood floor was completely burned, did not ignite. The contents of waste paper baskets, the bottoms of which were supported above the burning floor on metal legs from $1\frac{3}{4}$ to $2\frac{1}{2}$ inches high, also failed to ignite, although the papers near the bottom were decidedly charred. The waste paper baskets were without openings in the sides. The filing cabinets within the burnt area had sheet metal bases extending to the floor and their contents were generally ignited, from 40 to 60 per cent of the contents of four-drawer cabinets being made illegible by the floor fire. The contents of one cabinet, under which one-half of the floor and one-half of the adjacent baseboard were destroyed, did not ignite.

The burned portion of the floor and affected records were again replaced and the grate charged with 350 pounds of pine kindling which, saturated with kerosene, was ignited and the grate shield operated to give an exposure start for the fire. About the same extent of initial spread took place as in the exposure start with the cement finished floor. The fire in the wood floor progressed more rapidly than with the slow start for the fire, being about 20 inches from the opposite end of the room at four hours, when the fire was put out.

The average maximum room temperatures attained were higher than in previous tests with metal furniture, maximums from 404 to 885°C (759 to 1625°F) occurring during the first hour in the end of the building where the fire was started. In the opposite end the temperature maximums ranged from 265 to 570°C (509 to 1058°F) at three hours after the start of the test. The higher temperatures obtained only for a short time adjacent to the grate and after 15 minutes no temperatures over 570°C (1058°F) were recorded, and readings at only three points indicated temperatures over 450°C (842°F). The exposure generally was not sufficiently severe in intensity and duration to impair the strength of structural members of a building having the minimum protection generally provided in fire-resistive construction. Room temperatures above the ignition points of combustible materials were, however, maintained by the burning of flooring and exposed records for over three hours.

The contents of all table drawers, desks and open shelves as well as all exposed papers were consumed or charred beyond legibility. The contents of

two filing cabinets in the end near the grate were almost completely charred and rendered illegible. In the case of other cabinets, including a filing safe insulated with asbestos paper and an air space, under which the floor had burned out, the legibility of contents ranged from 15 to 80 per cent. Where the floor under the cabinets was partly or fully intact, the legibility ranged from 75 to 100 per cent. Water was applied between four and five hours after the fire was started, hence the data do not give information on the amount of damage to records if the fire had been allowed to burn itself out.

It is apparent that the results of these tests apply only where the occupancy is housed in a fire-resistive building where floor, bearing walls, or columns do not collapse as a result of the fire.

Tests with Record Storage in Wood Shelving.

In the fire severity tests with office occupancy in which mainly wood desks and filing cabinets were included, which with the wood floor present in some of the tests gave a combustible room content of 10 to 20 pounds per sq. foot of floor area, it was found that the resulting fires were not so severe, but that adequacy to resist them can, without difficulty, be incorporated in the constructions ordinarily employed in fire-resistive buildings. As previously indicated, this severity can be greatly reduced by using incombustible furniture and equipment. With larger concentrations of combustible materials, such as in the record and library rooms often found in office buildings, fires of considerably greater severity can occur. This was shown in some tests with records on closely spaced wood shelving giving total combustible content of 44 to 55.4 pounds per square foot of floor area, in which fires developed equivalent in severity to over six hours of the standard furnace test.* This condition requires heavier protection than the rest of the building, and inasmuch as these concentrations may be placed anywhere within the building, the general design would have to take them into account.

Tests with Record Storage in Metal Shelving.

The tests with metal shelving, which concluded the work with office occupancy, were undertaken to determine to what extent the fire severity from these concentrations can be reduced. The tests also gave considerable information on the reduction in rate of spread of fire from large and small fire origins.

In the first tests, metal shelving representative of several general types was used, nearly one half of the records being on "skeleton" type shelves having no partitions or backs. Others had partitions, but no backs, or backs without partitions, and one 29-foot single row had both partitions and backs with doors on two 3-foot bays. All shelving was 8 feet 3 inches high with 5 or 6 shelves, the weight of records in the 15 by 29-foot room being 21,330 pounds in all of these tests, or about 49 pounds per square foot of floor area.

*See previous reference cited.

Record storage on metal shelving, before fire test.

No wood top floor or other combustible floor finish was present in any of the tests with record room occupancy.

The first test was started with a waste paper basket fire in front of a single-depth bay, open at the front, but with metal back and partitions. The window shutters were opened to give the air supply deemed most favorable for fire spread, but no general fire condition resulted, the fire when put out at 7 hours 20 minutes, being confined to two 3-foot wide bays with some charred or glowing papers in a cupboard section adjacent to one of them.

The affected paper was replaced and fires were started in two piles of waste paper placed on the floor, one in front of shelving similar to that in the first trial and the other in front of a double-depth "skeleton" row. The fire progressed more rapidly than in the first test, particularly in the open shelving, and at the end of 1½ hours the whole room was involved. Collapse of skeleton type shelving began at this time and eventually involved all of the shelving that did not have partitions. All combustible contents of the room were completely consumed, the equivalent duration of the fire being, however, less by 25 to 30 per cent than in previous tests with wood shelving and an equal amount of records.

The room was fitted with new shelving, mainly of the backed and partitioned type with doors every third bay. Three double bays of well-braced skeleton type shelving were also included. One test with a slow start for the fire made in a manner similar to that of the first test described above progressed laterally through a 3-foot wide cupboard section and another 3-foot wide section with open front, in 20 hours, but no general fire spread resulted. A second fire in front of a double-depth open front, backed and partitioned bay spread through a closed front section on each side and involved the whole 18-foot wide stack in about 9½ hours. In this test the window shutters were kept at the lowest opening, and while this retarded the fire at some stages it enabled room temperatures to be built up high enough to cause general fire spread at 13½ hours.

The room was reloaded for tests with "exposure" start for the fire. This condition was approximated by starting a fire in oil-soaked wood kindling, filling a grate about 3 feet in diameter and 7 feet high as previously described. When the shield around it was withdrawn after the kindling was burning freely, the resulting air temperatures in most portions of the room rose above the ignition point of paper for 10 to 15 minutes. While fires started at many points they did not progress and at two hours the average room temperature was below 100°C.

Similar results were obtained in a second exposure start. After one hour the window shutters were closed to their lowest opening and the fires which had started in various portions of the room allowed to go on until air temperatures high enough to cause general fire spread were built up. This required about four hours, the fire in the skeleton bays being mainly responsible for the relatively rapid temperature rise. The contents of the whole room were soon involved, the fire being quite intense, but of shorter duration than in previous tests with record room occupancy. No collapse of shelving supports from fire exposure occurred during this test, most of the contents remaining on the shelves until consumed. The equivalent duration of the fire, while considerably above that found in any of the tests with the desks and filing cabinets referred to above, was lower by 35 to 40 per cent than obtained in comparable tests with an equal amount of records on wood shelving. The shelves in these tests were generally spaced 12 in. or more apart, the vertical partitions, where present, being spaced 3 ft. apart.

Insulated Record Containers.

Relative to the protection afforded by insulated containers, such as safes and vaults, this can be stated to be much less dependent on surrounding conditions than that obtainable with the uninsulated containers discussed above. Insulated safes such as those covered by Federal Specification No. 60a and nearly comparable classifications issued by the Underwriters' Laboratories have fire resistance sufficient to protect their contents in fires equivalent in

severity to the first hour of the standard furnace test for the lower degrees of protection and to four hours for the higher degrees of protection afforded. These containers also have considerable resistance against impacts such as those to which they may be subjected where non-fire-resistive constructions collapse in fires. Very prolonged heat exposure may result from burial in hot débris for a period after the fire and under some conditions of this kind even the most resistive safes will fail to preserve their contents. Full protection against such conditions can be obtained with vaults having masonry walls of proper thickness and well-insulated doors.

Protection of Records in Large Volume.

The protection of records in insulated safes and vaults is in general comparatively expensive and involves some sacrifice of convenience in their use. For many activities, however, only a small percentage of the records in current use has high value and this could be given the protection afforded by insulated safes and vaults.

Where a large volume of records having high value is to be protected, it will generally be found necessary to attain the required degree of protection by (1) housing the occupancy in a fire-resistive building having a minimum amount of combustible finish and trim, (2) providing protection against the communication of fire to the area concerned from neighboring buildings or from other portions of the same building, (3) providing record containers of material and design that will afford the minimum opportunity for fires to originate and spread in their contents and (4) avoiding accumulations of other combustible materials within the areas used for the safe-keeping of records.

Fire Record of Capitol Buildings.

Recent fires in State Capitol buildings have been given considerable publicity and have to some extent served to awaken the authorities in charge of these buildings to a proper consideration of their fire hazards and to a sense of responsibility for the safety of the occupants, records and other valuable contents. The fire record of these buildings has, on the whole, been fairly favorable considering the potential hazards, but a sufficient number of large loss fires have occurred to indicate clearly that serious hazards do exist that may result in serious damage to the structures, loss of irreplaceable records and possibly involve loss of life. Buildings can be replaced, but original records destroyed, or lives lost, are gone forever.

Structurally most of these buildings are built on monumental lines, impressive from an architectural standpoint and, outwardly at least, of substantial construction. At a casual glance, such structures seem practically immune from the possibility of serious fire. However, in spite of this apparent solidity many of them possess almost every defect possible from the standpoint of fire danger and unless compensating protection features have been introduced they offer serious fire hazards. Many of them contain immense quantities of combustible material in the form of wooden floors, wood trim, railings, lockers, shelves, closets and even wooden ventilating ducts. This combustible interior construction is augmented by the vast accumulation of desks, chairs, filing cases, books and records characteristic of office occupancies. High ceilings, wide stairways, light wells, open elevator and dumb-waiter shafts, and roofs so constructed as to afford immense concealed attic spaces, offer ideal conditions for the rapid spread of fire. Basements and attics are often given over to storerooms full of combustible material.

Practically all capitol buildings in addition to being office buildings are repositories of documents, records, historical relics and paintings. When such irreplaceable material is destroyed, no money value can measure its loss. It seems reasonable to assume that the presence of so much priceless material would prompt the adoption of safeguards for preventing fires and provide for their rapid extinguishment should they occur. Surprising though it may be, the contrary seems to have been the case. There has existed a curious indifference on the part of the public at large and many public officials to the presence of these dangers, and some of the most valuable historic treasures are subjected daily to hazards that would not be tolerated in a modern industrial establishment.

Often the building supervision is lax. "What is everybody's business is nobody's business" may be the explanation of the apparent indifference toward the upkeep of public property. Janitors of public buildings often develop a carelessness in keeping with lax supervision, and oily rags, mops, dustcloths, etc., find their way into odd corners, closets and pockets. Add to lax housekeeping unrestricted smoking (a difficult hazard to restrict and control), and it is clear that the fire peril of these buildings is very real.

The fire record files of the N.F.P.A. Department of Fire Record contain reports on twenty-five fires occurring in Federal, State and Provincial Capitols in the United States and Canada during the past twenty-seven years. This record is by no means complete in that it does not include the many small fires which occur from time to time in these buildings (as in other occupancies) of which little or no record is made. It does embrace all the major losses that have occurred in this type of occupancy since 1900.

The following fires in Capitol buildings make up the N.F.P.A. record for this occupancy:

Large Losses.

Date	City	Building	Loss
Jan. 4, 1904	Des Moines, Ia.	Iowa State Capitol	$125,000
Feb. 27, 1904	Madison, Wis.	Wisconsin State Capitol	275,000
Sept. 1, 1909	Toronto, Ont.	Provincial Capitol	388 000
Feb. 5, 1911	Jefferson, Mo.	Missouri State Capitol	1,000,000
Mar. 29, 1911	Albany, N. Y.	New York State Capitol	5,500,000
Feb. 3, 1916	Ottawa, Ont.	Canadian Parliament Building	3,000,000
Jan. 3, 1921	Charleston, W. Va.	W. Virginia State Capitol	400,000
Mar. 2, 1927	Charleston, W. Va.	Temporary Capitol	150,000
Feb. 23, 1929	Frankfort, Ky.	Old State Capitol	50,112
Dec. 28, 1930	Bismarck, N. D.	North Dakota State Capitol	728,000

Small or Moderate Losses.

Date	City	Building	Loss
Apr. 9, 1912	Denver, Colo.	Colorado State Capitol	Moderate
Sept. 24, 1919	Ottawa, Ont.	Canadian Parliament Building	Slight
Jan. 21, 1920	Washington, D. C.	Federal Capitol	$1,000
Feb. 1, 1924	Lansing, Mich.	Michigan State Capitol	None
Sept. 10, 1925	Boston, Mass.	Massachusetts State Capitol	Moderate
Oct. 24, 1925	Boston, Mass.	Massachusetts State Capitol	12,000
Feb. 26, 1926	Washington, D. C.	Federal Capitol	Moderate
Jan. 16, 1928	Helena, Mont.	Montana State Capitol	1,000
Apr. 8, 1928	Lansing, Mich.	Michigan State Capitol	Slight
May 1, 1928	Lansing, Mich.	Michigan State Capitol	Slight
Jan. 3, 1930	Washington, D. C.	Federal Capitol	3,000
Apr. 14, 1930	Baton Rouge, La.	Louisiana State Capitol	Moderate
Dec. 24, 1930	Montgomery, Ala.	Alabama State Capitol	600
Jan. 19, 1931	Lansing, Mich.	Michigan State Capitol	5,000
Jan. 23, 1931	Topeka, Kans.	Kansas State Capitol	Moderate

That there are a considerable number of other minor fires in Capitol buildings was brought out by the official report of the Canadian Parliament Building fire, which tabulated some fifteen fires of a minor nature which had occurred in government buildings in Ottawa during a four-year period. Such minor fires, though each may be a potential conflagration, are seldom reported, and very few of them are recorded in the N.F.P.A. fire record files.

Construction of Buildings.

The twenty-five fires listed above occurred, with one exception, in buildings of three or four stories in height. The construction of these buildings was as follows:

Type of Construction	No. of Fires	Known Loss
Fire-resistive	7	$17,000
Semi-fire-resistive	1	125,000
Brick or stone—wooden interior	11	10,953,712
Frame	1	150,000
No data	7	393,000
Total	25	$11,638,712

Note: The fire which destroyed the frame building listed above spread to, and involved, an adjoining two-story brick-joisted building.

Of the five fires in fire-resistive buildings, three occurred in the Federal Capitol at Washington and two in the Massachusetts State Capitol at Boston.

These statistics amply bear out the statement previously made that in spite of their apparent solidity Capitol buildings may be subject to severe losses by fire. Not only were most of these buildings of combustible material with combustible contents, but their construction was in a number of instances of such character as to offer unusual opportunity for the rapid spread of fire and at the same time act as an impediment for effective fire fighting.

The point of origin of the fires was as follows:

Point of Origin.	
Record storerooms	5
Basement—service rooms	3
Ceiling and ceiling space	3
Closets, lockers and janitor's rooms	3
Walls, partitions, etc.	2
Roof spaces	2
Reading rooms	2
All other places	5
Total	25

There is but one instance of a fire occurring in a building equipped with automatic sprinklers. This was on December 24, 1930, at 10:45 P.M. in the Alabama State Capitol Building at Montgomery. The fire originated in a

small room on the second floor used for the storage of records and stationery supplies. A lighted cigarette had been left burning on a shelf, igniting paper records and stationery.

Two sprinkler heads opened and completely extinguished the fire. The local sprinkler alarm operated satisfactorily, but the aged watchman did not know its purpose and the fire was not discovered until he heard the water running and notified the building superintendent, who in turn called the fire department by telephone. The loss, for the most part from water, amounted to $600. The amount of loss would have been materially reduced had a more alert watchman, one aware of the use and operation of sprinkler systems, been on duty.

The value of sprinkler protection was well demonstrated in this fire, for it occurred in a small closed room late in the evening and was beginning to spread to a blind attic above when checked by the sprinklers. Had no protection been provided, the fire would not have been discovered until it broke through the roof and would have probably been difficult to extinguish.

Causes of Fires.

An analysis of the causes of these fires shows that they were largely due to the neglect of ordinary hazards and practically all of them were preventable.

Cause		No. of Fires
Defective wiring or short circuit		4
Rubbish and sweepings		3
Spontaneous ignition oily material		2
Smoking—matches		2
Mechanic's carelessness		2
Electrician's candle ignited wooden duct	1	
Roofer's brazier started fire in roof space	1	
Other known causes		6
Unknown		6
Total		25

Losses.

The following table shows the loss experience in Capitol buildings classified in accordance with the amount of the loss.

	No. Fires	Known Loss
Slight or not over $1000	7	$2,600
Over $1000 but less than $100,000	4	70,112
Over $100,000	9	11,566,000
Moderate	5	No data
Total	25	$11,638,712

The following summaries of individual Capitol fires are presented as typical of the fire experience of this class of buildings.

Open partitions and combustible false ceiling work permitted a fire, starting from a candle left burning by an electrician, to spread through the upper story of the Iowa State Capitol at Des Moines. The fire department was severely hampered by inadequate water pressure.

Des Moines, Iowa, January 4, 1904.

The Iowa State Capitol building was an imposing building surmounted by a dome, situated on a hill overlooking the city. It was three stories in height and of semi-fire-resistive construction, so-called. The exterior walls were of brick filled with concrete, with brick interior walls, wrought iron beams, cast iron columns and brick arches. There was considerable false work in the upper stories, with wood furring and studding, and wood lath and plaster. Wood ducts and air shafts extended throughout the building. The garret over the entire building communicated with the dome. The building was thought so safe that no insurance was carried.

The fire had its origin in the daytime on the third floor in a small room adjoining the Speaker's room. An electrician had cut an opening above the wainscotting in which to insert a cut-out box. The space cut into was between an air duct and the corridor partition. The electrician used a candle in his work and left it burning while absent in other parts of the building. This candle started the fire.

The space where the fire started was cut off by brick arches at the floor, preventing the spread of flames downward. Above, however, it communicated with the open space above the false ceiling work over the Hall of Representatives, which, with the draft supplied by the opening, permitted the flames to continue until they died out from lack of combustible material.

The fire was prevented from spreading throughout the building by the closing of the two doors in the main fire wall at the south side of the Hall of

Representatives and by the closing of the openings leading to the air ducts under the dome. The fire fighting was hampered by the lack of any private fire-fighting equipment and low water pressure, the fire department being unable to get water higher than the floor of the Hall of Representatives.

The damage was confined to the north wing of the building. The galleries and false ceiling fell in and the roof space was burned out. The loss was estimated at $125,000.

Madison, Wisconsin, February 27, 1904.

A gas jet too near a highly varnished ceiling of yellow pine was the cause of a fire which gutted the Wisconsin State Capitol at 3 A.M. on the morning of February 27, 1904.

The Capitol building was a large structure approximately 225 x 400 feet arranged in the form of a Greek cross with corridors extending from a rotunda in the center. These corridors, high and fairly narrow, acted like flues, for flames appeared simultaneously from windows at the extreme north and south ends. The building was old, having been erected in 1839 with various subsequent additions. Its original cost was $900,000.

The fire occurred in the south wing, where new partitions of varnished yellow pine had been installed in place of plaster. It started on the second floor from the cause mentioned above and extended to other parts of the buildings by way of corridors, concealed spaces and wooden roof structure. The south wing from the second floor up was entirely destroyed and the north wing was badly damaged. The loss was estimated at $275,000.

A gas jet too near a highly varnished ceiling of yellow pine was the cause of a fire which gutted the Wisconsin State Capitol at Madison. High and narrow corridors favored the spread of flames throughout the highly combustible interior.

Toronto, Ontario, September 1, 1909.

The west wing of the Parliament Buildings was badly damaged by fire at noon on September 1, 1909. The Cabinet Council was in session when a crash of glass was heard. Investigation disclosed the western skylight had fallen into the light well and heavy smoke was pouring from the roof. An alarm was telephoned to the fire department and an effort made to check the blaze with private fire-fighting equipment.

It is said that there was a delay of some twenty minutes in the arrival of the fire department, which with a strong wind made it impossible to save the west wing. The law library was a total loss. Defective wiring was at first blamed for the fire, but it was later determined that it originated from a lighted charcoal brazier left unattended during the noon hour by a roofer repairing the eaves on the roof. The loss was estimated at $388,136, of which $250,000 was on contents. The building loss was fully covered by insurance, but only $8,000 was carried on the contents.

Jefferson, Missouri, February 5, 1911.

The State Capitol of Missouri was typical in construction, having substantial brick walls and combustible interior, surmounted by an ornamental dome. The fire occurred at 7:45 P.M. during a severe thunder storm and was caused by lightning striking the dome. It is said that it could have been brought under control with fire extinguishers had it been attacked in time.

There was some delay in the response of the fire department (mostly volunteer), which was summoned by telephone. Eleven hose streams using small nozzle tips were employed, but were not effective in reaching the seat of the fire and the fire department waited for the fire to burn down to them.

The loss was estimated at approximately $1,000,000 with no insurance. The governor had recently canceled all policies on state property to save money.

Albany, New York, March 29, 1911.

The Capitol building at Albany is said to have cost $30,000,000. The people of this great state seem to have been justified in believing that a building costing so much and presumably representing the last word in public building design and construction would be a safe place for their valuable archives and relics. But early on the morning of March 29, 1911, it was visited by a serious fire which badly damaged the State Library and destroyed by fire, smoke and water vast quantities of valuable documents.

The fire occurred at 2:41 A.M. in the northwest part of the second floor occupied by the Assembly Library. The fire was discovered by an employee of the Assembly who returned to the library to close his desk preparatory to going home. He found a book shelf behind his desk on fire and the flames

Brown Bros.

Priceless books and records were destroyed when fire swept through the west wing of the New York State Capitol at Albany. Lack of proper maintenance of electric wiring was blamed for the fire.

mounting upward through the books stacked to a height of 30 feet from the floor. He shouted an alarm to a watchman and others, who in turn transmitted a call to the fire department.

A balcony ran about the library, forming a mezzanine floor some 12 feet from the main floor. By the time the fire department arrived this balcony was ablaze and heat and smoke were pouring out into the corridor. From the street a stream was directed into a window of the library and other lines were taken up the winding stairs inside. It was thought that the fire could be confined to the section adjacent to the Assembly chambers.

However, ten minutes later, the flames reached the head of the great western stairway and were swirling up the elevator shaft in the corner of the building. The State Library occupied the greater part of the west wing from the third floor up and it was hoped that the fire could be kept from this section. This did not prove possible, for the fire entered the wing by way of the binding room located on the fourth floor.

This was fully an hour and a half after the fire started and in that time had there been anyone on hand to do the work, many of the priceless books and records in the Library could have been saved. It is said that the state employees on hand were hopelessly inefficient and inadequate. They are said

to have stood about in idle groups on the first floor of the building while many thousands of dollars worth of state property was needlessly destroyed.

In the meantime the fire department redoubled its efforts to check the spread of fire. In this they were successful, although the Library was completely destroyed. The fire was kept from the Assembly chamber proper and also prevented from entering the costly Senate chamber. It was early realized that if the fire once got headway in the region above the Senate chamber the whole building would be doomed.

The Assembly chamber was somewhat damaged when the fire got into the famous papier-mâché ceiling (a scandal of 1886) and it crashed to the floor with two chandeliers. Hose streams were at hand and extinguished the fire with little damage from flames. Smoke and water wrought havoc, however. The Senate chamber was but slightly damaged by smoke and water.

The massive granite blocks of the outer walls, and the carved sandstone arches and marble columns in the corridors of the western wing were badly affected by the heat. The grand western staircase was also badly damaged. The iron framework of the slate roof along the western side twisted and broke away and the roof caved in along this side. One tower, one of four at the corners of the structure, fell.

The cause of the fire was believed to have been a short circuit of electric wiring. Most of the wiring was twenty years old. According to a report made by the state architect, the wiring throughout the building was defective.

The loss was estimated at $5,500,000 of which $1,600,000 was on the building. One life was lost, that of a watchman, who is thought to have been overcome by smoke while trying to find his way out of the burning structure.

This fire was apparently lost due to two factors. Indifferent housekeeping and lack of proper inspection created untidy conditions. No thought had been given to the most elementary features of fire protection and no first aid equipment was available at the start of the fire.

Ottawa, Ontario, February 3, 1916.

One of the most impressive groups of government buildings in America is that of the Canadian Parliament Buildings in Ottawa. Located on a high hill overlooking the river this group of massive stone buildings with its long Gothic façades and its lofty tower seem made for eternity.

These buildings were typical of their class. Their walls, to be sure, were of stone and to the casual observer gave the impression of great solidity. But within they were filled with combustible construction and contents. The official report of the fire indicates that the chief of the Ottawa Fire Department had from time to time endeavored to convince the authorities of the existence of fire hazards and had urged the need of better protection. But delays and postponements had held up any action and the inevitable disaster resulted.

Brown Bros.

In spite of the apparent solidity of the Canadian Parliament Building at Ottawa, the structure proved a ready prey to flames. Seven persons lost their lives and a property loss of approximately $3,000,000 resulted from the fire which occurred on February 3, 1916.

Origin of Fire.

The fire had its origin at about 8:55 P.M. in a room on the first floor used as a newspaper room containing six double reading tables with shelving on which newspapers were placed. There were screens or partitions on each side of the room on which newspaper files were hung. Around the room was a gallery containing shelves on which were piled papers, books, etc. Most of the furniture and fittings were of white pine, oiled and varnished and highly combustible.

The fire started in a file of papers on a shelf on one of the reading tables. It was first observed by a Member of Parliament who happened to be in the room. He states that he felt a blast of hot air, smelled the odor of burning paper and looked around to see the smoke and flame coming from the table. He called a police officer on duty outside the room, who obtained a fire extinguisher and endeavored to extinguish the fire.

Story of the Fire.

The fire gained headway rapidly and the efforts of the officer with the extinguisher were of no avail. A hose stream was apparently brought into play also, without effect, and the fire spread to the corridors of the House of Commons. Once outside the reading room the heat and flame spread laterally through the corridors and upward into the roof space over the Commons and Senate chambers, where it raged unchecked in the white pine timbers. There were no fire doors or stops in the building, with the exception of one to the Library, which evidently was a factor in stopping the spread of the fire in this direction.

According to records of the Ottawa Fire Department the first alarm was received at 8:57 P.M. from the automatic fire alarm system installed in the buildings. Within two minutes the first company was on the Hill. The fire by this time had broken through the roof. This rapid spread of fire is attributed by the chief to the fact that lack of fire stops permitted its ready access to the tinder dry roof space and the presence of a glass ceiling over the House of Commons and Senate chamber, which probably gave way in the early stages of the fire, allowing the fire to drop down into these rooms, which were completely burned out.

Additional alarms were immediately transmitted, and as they arrived, hose and engine companies were placed at all available hydrants, and within a short time twenty streams were playing on the fire. In spite of their efforts, however, the fire extended through practically the entire building. A mere chance saved the Government Library. The wind blowing in the opposite direction fortunately carried the fire to other parts of the building. The fire was officially pronounced under control at two o'clock on the morning of February 4th.

At the time of the start of the fire the House of Commons was in session, with members and guests present. Some of them escaped by way of the regular exits, but others were cut off and had to be rescued by means of ladders by the firemen. In spite of the efforts of the fire department two women guests, who had been in the House gallery, were trapped. They were rescued about thirty minutes after the start of the fire, but died from smoke inhalation and shock. Two men, one a member of Parliament and the other a law clerk, were trapped and burned to death. A police officer and two government employees engaged in fighting the fire with a stream from one of the standpipes in the building were killed when a tower collapsed, burying them under tons of débris.

The exact cause of the fire has never been definitely determined, but many circumstances connected with its origin tended to lead to a strong suspicion that it may have been incendiary incidental to the World War, at that time in progress. The loss was estimated at $3,000,000.

Charleston, West Virginia, January 3, 1921.

Three and four stories in height, of large area, with stone faced brick walls and mansard roof, surmounted by a clock tower 194 feet high and of wooden interior construction, the West Virginia State Capitol was built to burn. Although numerous brick division walls separated the interior into sections, they were pierced by large unprotected openings, and open stairways and elevator shafts ran from the basement to the fourth floor.

The fire was first observed at about 3:15 P.M. in a storage room in the attic over the Senate chamber. It was discovered by a stenographer, who was

Combustible interior construction, unprotected openings and indifferent fire fighting were factors in the total destruction of the State Capitol at Charleston, West Virginia, on Jan. 3, 1921.

passing through a corridor on the second floor, when she saw smoke coming from the attic. She immediately spread the alarm throughout the building and two janitors went to the attic to ascertain the source of the smoke. They hurried down and telephoned an alarm to the fire department. They then returned to the attic with a 40-gallon chemical extinguisher on wheels. This extinguisher, however, was apparently never used.

The fire department responded promptly and immediately sounded a second alarm. Two hose lines connected directly to hydrants were carried into the building to the attic in an attempt to confine the fire to the Senate wing, but due to the fact that the division wall did not extend to the roof, the combustibility of the roof structure and the lack of adequate pressure for the hose streams, these two lines were unable to materially retard the spread of the fire at this point.

One line was soon removed, followed by the other when the fire spread to the central part of the building. An attempt was made to operate a hose line on the roof, but the spread of fire soon made this impossible. For the most part the fire was fought by six hose streams from the ground outside with little or no effect. These six lines, after considerable shifting, were finally all connected to pumpers.

Many valuable records were lost, but the heavy brick vaults withstood the heat and the records stored therein were recovered in good condition. In this connection West Virginia was fortunate, for the Massachusetts State Library had a complete collection of the official documents of her sister state

and while the originals could not be replaced, official copies could be made.

A brick gable with a heavy stone arch over a dormer window fell when the roof collapsed, killing one man and severely injuring another. Several other men who were engaged in removing records from the building were slightly injured. The original cost of the building in 1888 was $400,000 and the loss was total.

Charleston, West Virginia, March 3, 1927.

Following the fire of 1921 the principal offices of the West Virginia State Government were housed in a temporary wooden building and an adjoining brick dwelling that had been remodeled for the purpose. The temporary building, often referred to as the "pasteboard" Capitol, was hastily erected with a wooden framework, clapboard walls, shingled roof and interior partitions of composition wallboard. It had always been regarded as a fire hazard and special regulations relative to smoking had been made from time to time to reduce the danger from this source.

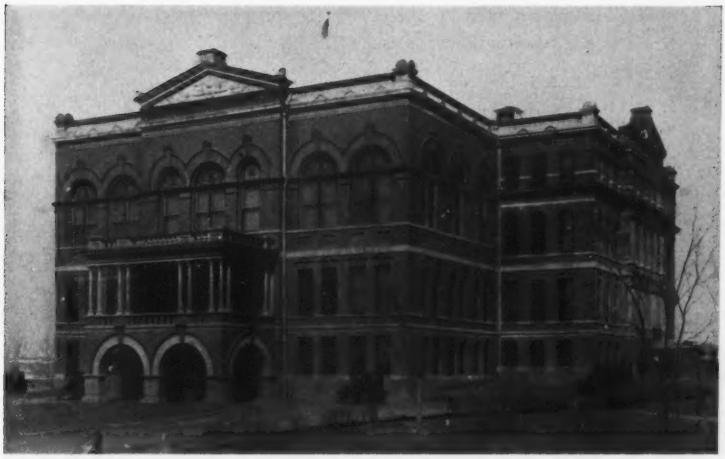
The fire appears to have started in the janitor's closet on the second floor from an unknown cause. It was discovered at 2:30 P.M. by a man passing through the corridors, and although an alarm was promptly given, thirty minutes after the fire was discovered the building was practically burned to the ground. The fire spread to the adjoining brick building, which was completely gutted, and to several near-by dwellings.

Valuable records were again destroyed in this fire, although some were preserved in a brick vault and in safes and cabinets which withstood the fire. Other records were loose on desks or in cabinets and files which failed to protect their contents even in a fire of short duration. The loss to the State was set at $150,000.

Bismarck, N. D., December 28, 1930.

When the State was still part of Dakota Territory, back in 1883, people traveled miles to stare in pride and wonder at the famous brick Capitol with its "gingerbread" architecture. International diplomats, noblemen and famous army and other government officers witnessed its dedication. Like other Capitols, however, it came to an ignoble end when fire ravaged it from roof to cellar on the morning of December 25, 1930.

The cause of the fire has not definitely been ascertained. According to an official report made by the State Fire Marshal the fire was discovered by the janitor, who had been in the room of origin (the janitor's supply room) about an hour prior to the fire. He was working in an office on the ground floor in the extreme southeast corner of the building at about 8 A.M., when he heard an unusual roaring noise. He went into the corridor to ascertain the



Finney's Photo Service.

The Capitol of North Dakota, situated in the prairie two miles from Bismarck. Erected in 1883, with brick walls and wooden interior construction, it was "built to burn."

source of the noise, but discovered nothing, so returned to work. A few minutes later he heard a loud report resembling an explosion. He then went outside the building and discovered smoke and flame coming from windows on the third floor directly above the janitor's room. It is thought that the noise resembling an explosion may have been due to the falling of some heavy object released by the fire.

The fire department was immediately summoned and responded promptly. They were somewhat handicapped by a limited amount of hose and at times the pressure was inadequate. The fire swept through the third floor of the main building and into the wings and within a half hour had worked its way downward into the second floor. Shortly after nine o'clock the main floor was ablaze and much of the basement was involved.

Hose streams were concentrated on the north wing in an attempt to protect the vaults in the treasurer's and insurance departments. Little else, however, could be preserved. By noon the building was completely gutted and by evening nothing remained but smouldering embers and ashes. The vaults throughout the building had been constructed of brick and concrete and as a whole held well. Where departments were provided with those vaults it was found after the fire that the records were safe. Records contained in filing cabinets and other containers in the individual offices were a total loss except where they were salvaged before the fire reached them.

Men, women and children who rushed to the scene to see the fire all pitched into the work to salvage as much of the records and equipment as

Finney's Photo Service.

Starting between the second and third floors of the North Dakota State Capitol at Bismarck, the fire worked its way downward until four hours later nothing remained but smoldering embers and ashes. Handicapped by limited equipment and water supplies, the fire department could do but little.

possible. The salvaged material was relayed along lines of persons leading from the various windows, and the material saved was carried in each case several rods from the building. This process was maintained until it was impossible for workers to remain in the building.

The various state offices have been located in different buildings in the city and plans were immediately made for the erection of a new and better Capitol building. The loss amounted to $728,000, covered by insurance. The state already had established a building fund for a new Capitol and this, with the insurance, should make possible the construction of a suitable fire-resistive building.

An editorial from the Boston *Herald* summarizes the story:

The Capitol of North Dakota was not a handsome building. Situated in the prairie two miles out from town it was not conveniently placed. The loss of such a structure is not a calamity to be deeply mourned. If now there shall be erected a building more original in design and better arranged for business, the state will be the gainer in the long run.

But the burning of the state archives is quite another matter. For years North Dakota will have to stagger along somehow, replacing precious originals with certified substitutes, searching everywhere for authentic documents, and gradually accumulating a new store of official papers. But the loss of the archives never can be wholly made good, although ways will be devised to enable the state to continue to do business in a relatively inefficient manner.

The disaster should serve as a warning to every other state. Washington at last is to have a fireproof archives building, and long it has been needed. Every state ought to have such a building, or at least a department or annex so fireproofed as to insure absolutely the safety of irreplaceable files and documents.

Lansing Capital News.

The damaged corridor of the Michigan State Capitol at Lansing after the fire of Jan. 19, 1931. Civil war muskets and other relics were badly charred by flames, which originated in vicinity of news stand at right of picture.

Lansing, Michigan, January 19, 1931.

The Michigan State Capitol when erected in 1872 was considered to be of first class construction. Judged by modern standards it left much to be desired. Considerable wood trim was present in the building and an unprotected elevator shaft adjacent to the point of origin of the fire gave an opportunity for its spread to upper floors.

The fire started shortly after midnight near a news stand at the east basement entrance. It was discovered by a watchman on the fourth floor. Smelling smoke, which was pouring up the elevator shaft, he turned in an alarm to which the city fire department immediately responded.

The blaze, for the most part, was confined to the section of origin and the damage elsewhere was caused by smoke. The news stand was entirely destroyed and flames shot up the elevator shaft directly across from the news stand and seared paint and varnish in the shaft as well as a small section of varnished woodwork where the shaft passes through the second floor. The tax book division of the auditor general's department, located just off the hallway, was seriously threatened for a time, but except for the destruction of a few record books easily replaced, it did not suffer much damage. The fact that the elevator had been stopped at the first floor probably prevented more serious damage to upper floors.

Smoke did considerable damage to the historic war museum located in the rotunda of the building on the first floor. While most of the relics were under glass covers in cases, they were considerably smoked up and several large pictures suffered to a considerable extent.

An investigation following the fire revealed that sweeping compounds had been used extensively on the floor where the fire started and that the janitors had made it a practice to add oil to them. The testimony of one witness indicated that linseed oil was used. From this and other evidence it seems probable that the fire was due to spontaneous ignition in an accumulation of sweeping compounds under the news stand.

The inquiry also revealed that, due to the fact that painters had been at work in the rotunda and adjacent corridors, the corridor in which the fire originated had been locked for a number of hours preceding the fire, although no painting had been done in this particular corridor. No one was permitted on the basement floor, the watchman being instructed not to cover this floor during the night. It seems probable that the fire might have been discovered and extinguished in its incipiency had not the watchman's service been thus curtailed. The loss was approximately $5000. This fire is said to have been the most disastrous in the history of the building. Following a minor fire which originated in the paper baling room of the structure some two years ago, automatic sprinklers were installed in that section.

The Polish National Alliance College Fire.

The Polish National Alliance College was an imposing structure. Situated on a hilltop above Cambridge Springs, Penna., it dominated the landscape for miles around. A brick exterior surface gave to the casual observer an impression of substantial construction, but the fire resistance was only skin deep, and when fire came on January 20, 1931, the destruction was complete.

The building was erected in 1898 as a year-round resort hotel, but from the start it was a failure from a financial standpoint. In 1910 or 1911 it was purchased by the Polish National Alliance and with the exception of a short period during the war, has been occupied for college purposes. The structure had a ground area of 42,800 square feet, was five to seven stories in height and was of frame brick-veneer construction.

The building contained under a single roof practically all the functions and activities of the college except the gymnasium and the heating plant. The kitchen, laundry, dining hall, library and auditorium were on the lower floors, while classrooms, laboratories and dormitories occupied the upper floors. In former years the student enrollment had been above 400, but at the time of

This report has been prepared from data furnished by Louis Wiederhold, Jr., of the Underwriters Association of the Middle Department (Member N.F.P.A.), supplemented by information from various other sources.

Allan Rust Maxwell.

The Polish National Alliance College at Cambridge Springs, Pa., was housed in this spacious resort hotel building of frame brick-veneer construction. Situated on a high hill, it was a landmark for miles around.

the fire there were 222 students and about thirty members of the faculty.

The basement and kitchen were equipped with automatic sprinklers. There were no sprinklers in any other portion of the building. The water supply to sprinklers was deficient and the system was sub-standard in other particulars. It was not a factor in the present fire.

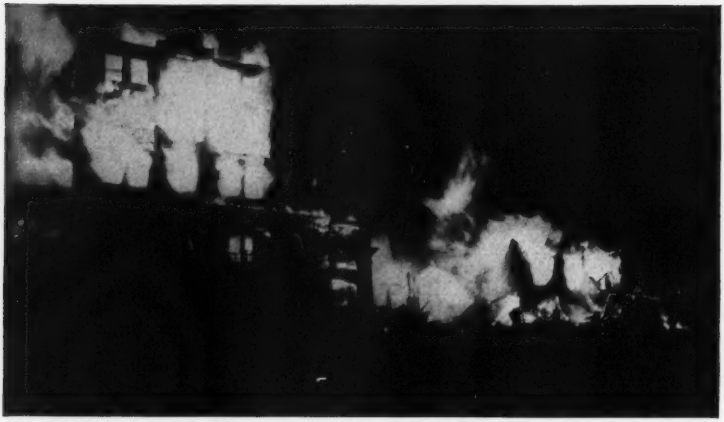
A standpipe with hand hose connections was provided in each wing. There was a good supply of water pails and 2½-gallon soda-acid extinguishers.

Story of the Fire.

On the evening of January 20 the entire student body and faculty, together with a number of townspeople, were attending a lecture in the college theatre on the ground floor of the building. The lecture had just started when the Dean of the College announced that a small blaze had been discovered in a distant part of the building and directed that the theatre be emptied. Sensing no danger, some of the townspeople lingered in the lobby. The fire started at about 7 P.M. on the top floor of the west wing of the building in the roof space above the biological laboratory, probably due to defective electric wiring.

The Cambridge Springs Fire Department (mostly volunteers) was notified and is said to have responded promptly. A hose line was carried to the top floor and to the roof. As the building was located on a hill at about the same elevation as the standpipe located on another hill, the water pressure proved inadequate and the fire gained in momentum and intensity. Fanned by a high wind, the entire structure was soon ablaze.

Help was summoned from Edinboro, Meadville and Erie. The first two communities responded and were of considerable assistance in preventing the spread of the fire to the gymnasium and heating plant situated about fifty feet from the burning structure. The Erie Fire Department started, but was forced



Allan Rust Maxwell.

"Built-to-burn" construction, a high wind, inadequate private fire protection, and a low water pressure were all factors which permitted a seemingly insignificant blaze in the roof space to sweep through the entire structure of the Polish National Alliance College in less than two hours' time.

to turn back by a heavy snowstorm. This same snowstorm, however, was a factor in preventing a general conflagration, for the roofs of dwellings on near-by streets were showered with sparks and live embers.

By 7:45 P.M. all hope of saving the main building was abandoned and the firemen turned their entire attention to saving the gymnasium and power plant, representing a $200,000 investment, which caught several times, but were saved. In about two hours' time the building was razed and nothing remained but the stone archway and the brick chimneys at the main entrance, towering over a vast heap of smoldering embers.

The loss to the building and contents has been set at $625,629, against which was carried insurance amounting to only $125,000. The library and all laboratory equipment were practically a total loss. Many valuable historical relics were destroyed. Among them were said to be letters exchanged by George Washington with distinguished Poles who aided him in the Revolution.

The fact that the entire student body was on the first floor possibly prevented serious loss of life. Had this fire occurred during the night it is probable that it would have spread with such rapidity that some of the 200 or more students would have been trapped in their rooms.

Buildings of this character should not be occupied for school or institution purposes, but if they must be so used, automatic sprinklers and fire alarm protection should be provided.

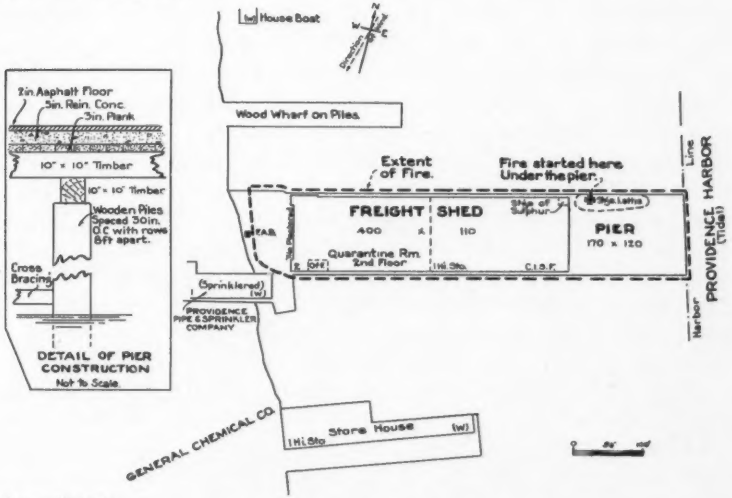
The lesson of inadequate protection of valuable records is again exemplified in this fire. Priceless relics of historical value and a library containing rare and irreplaceable books were destroyed.

Rhode Island State Pier Fire.

A serious fire of unknown origin swept the under portion of the Rhode Island State Pier at Providence in the early morning hours of February 25, 1931. This fire is of particular interest because the pier was thought to be relatively safe from fire, being constructed of steel and concrete with a concrete floor surface, and having automatic sprinkler protection throughout the pier shed. It is also of interest in that it again indicates the hazards incidental to the highly flammable coating of bilge oil on the piling and timber beneath the wharf, and emphasizes the hazard of large unbroken areas under wooden wharves and piers beyond the reach of hose streams. In this last feature it was similar to the fire which occurred on March 22, 1930, at the pier of the Lamport and Holt Line in Hoboken. (QUARTERLY Vol. 23, No. 4, page 437.)

The Property Involved.

The property involved in this fire was known as State Pier No. 1 and was constructed by the State of Rhode Island in 1914. It was occupied as a freight terminal for transatlantic shipping. The pier itself was approximately 650 ft. long and 120 ft. wide and was supported on creosoted wooden piles. The pier deck consisted of 10 in. x 10 in. timbers supporting a 3-in. plank deck on which had been laid reinforced concrete slabs, 5 in. thick, surfaced with 2 in. of asphalt.



Factory Mutuals.

Diagram of Rhode Island State Pier, Providence.

The building on the pier was 400 ft. long and 110 ft. wide and was constructed of steel and concrete. The front section at the land end was two stories in height and occupied as offices and immigration detention rooms. The remainder of the building was one story in height and used as a freight shed. The two-story section was of steel and concrete construction and the sides of the freight shed were iron-clad on steel frame with large sliding doors of wood, tin-clad. The roof was of planks supported by steel trusses. The steel trusses and girders were not protected.

The structure was equipped throughout with automatic sprinklers on a dry-pipe system controlled by four dry-pipe valves and supplied from the public mains. There were no sprinklers beneath the pier deck to protect the under surface of the deck or the piling, nor were there bulkheads to prevent the spread of a fire should one start.

A watchman was on the premises from 7:00 P.M. to 7:00 A.M. and made hourly rounds to five stations located in the building. He carried a clock, but was not otherwise supervised. It required about twenty minutes to cover his stations. On the morning of the fire the regular watchman was absent on account of sickness and a substitute, who had been employed for some time, was on duty.

Origin and Discovery of the Fire.

The fire started sometime on the morning of February 25, 1931, underneath the unbroken concrete floor slabs, either in the planking and timbers over the wooden piles or among the piles themselves. It is understood that the planking, timbers and piles had originally been impregnated with creosote and it seems probable that the piles had accumulated a deposit of oil scum, which is known to have been present at times in the river.

The exact point of origin of the fire and its cause are not known. The watchman stated that when he first saw it, the fire was raging from one end of the pier to the other and must have been burning a long time. He cannot even indicate at which end of the pier it may have started.

On the morning of the fire the watchman had made his rounds on the three o'clock trip and was at leisure about 3:15, when he detected the odor of smoke. He glanced out of the windows on the north side of the pier and then looked into the freight shed, but could not determine its source. The smoke became thicker and he went outside, where he discovered the fire reflected in the water. He ran to the fire alarm box, which was on a pole in front of the building, and supposed that he turned in an alarm. Apparently he turned the handle which opens the door and rings a bell, but he did not pull down the hook inside, for no signal was received at fire alarm headquarters. At about the same time the watchman at the General Chemical Company, which adjoins the pier on the south, discovered the fire and he attempted to sound an alarm from the private box on his premises by the same procedure, and with similar results.

International.

One hundred feet to the north of the Rhode Island State Pier was an open pier on which six pumpers were placed. Hose lines were carried aboard a tug boat, allowing firemen to approach closer to the burning pier and operate their streams effectively. (See also Frontispiece.)

After waiting some time for the fire department to respond, the watchman of the State Pier returned to the pier shed and telephoned. This call was received without delay and promptly handled. The nearest pumper company was immediately dispatched and a street box sent out because the telephone message indicated that the private box was out of order. While the street box was being transmitted to cover the telephone alarm, it was actually pulled by a police officer who saw the fire. After having telephoned to the fire department the watchman made his way to the roof, from which he was later removed by the firemen.

Story of the Fire.

When the first company reached the scene of the fire the under side of the pier was a mass of flame from one end to the other. At that time, however, there was no fire on top of the pier deck or inside the building. It was at once seen that the fire department had a difficult fight on its hands and a second alarm was immediately sounded, followed at later intervals by calls for additional individual companies, until twelve pumper companies (each equipped with a 1,000-gallon pumper) and two ladder companies were at the fire.

The Providence Fire Department has no fireboat, but it is not believed that a fireboat could have materially changed the outcome of the fire, due to its headway when discovered and to the fact that the fire was largely con-

fined to the wood piling under the concrete floor. There were only a few feet between the water line and their pier deck, so that fireboat streams could not have been directed low enough to reach the fire.

About 100 feet to the north of the State Pier was a smaller open pier on which six pumping engines were placed and by drafting from the river supplied a number of powerful streams. A tug was brought in between the two piers and hose lines were taken aboard, allowing the firemen to approach closer to the burning pier. The hose streams were effective in extinguishing the fire along the windward (north) side of the pier, but the remaining areas, well out of reach of hose streams because of the obstructions offered by cross bracing and timber work, burned fiercely. Other streams operated on the fire from the street side, but there was no way of reaching the open pier at the river end, and it was impossible to do any fire fighting on the south side due to the intense heat and smoke.

The piles on the south side of the pier gradually burned away and about 8:00 A.M. the front or office section of the pier structure began to settle toward this side. The steel and concrete members held their shape perfectly and the building leaned over until the south side rested on the river bottom, while the north side remained on the wood piles that were left. The top floor on the south side is now at about the level of the pierdeck on the north side, which is near its original level. When the piles and timbers underneath burned away, the stub ends of the piles punched holes in the concrete floor and allowed the fire to enter the main shed, where the automatic sprinklers operated and prevented serious damage to the larger portion of the structure, particularly at the river end, which did not collapse.

The Sprinkler System.

The sprinkler system functioned properly and was undoubtedly a factor in keeping the steel roof members cool and protecting freight stowed in the shed when the fire came through the openings in the concrete floor. When the structure settled, however, a number of pipe fittings were broken and, through the breaking of an 8-inch elbow in the heater room, the full capacity of the sprinkler system was impaired. This gave the fire an opportunity to spread, and it made its way into the second floor and roof at the shore end of the building, where it was extinguished by the fire department.

The generally satisfactory effect of the sprinklers is indicated by the condition of the pier after the fire. There was a wooden freight car on the railway tracks, which ran the length of the building. This car was not damaged, although it was directly over the center of the fire. An old automobile located on the north side of the pier showed no effects of the fire and its tires were not even damaged. On the north side of the warehouse there were a considerable number of wooden barrels, some containing bichromate of soda

International.

The piles on the south side of the pier gradually burned away, allowing the superstructure to settle until the south side rested on the river bottom.

and others containing soda ash. There were iron drums containing sulphide of soda and denatured alcohol. None of these showed effects of fire.

The sheds were well filled with freight of a general nature, for a ship had discharged a large cargo only the day previous to the fire. Some of this was burned and some fell into the water when floor sections collapsed. There were boxes of fish, cans of olive oil, cans of tomatoes and other foodstuffs, for the most part not touched by fire, but severely exposed to heat and water damage, all of which was condemned. The rooms on the second floor, occupied by the U. S. Immigration Service, were badly damaged.

The total loss to the State of Rhode Island is estimated at $500,000, only $150,000 of which is covered by insurance. Loss to contents of the building is thought to be about $250,000.

Conclusions.

An analysis of the factors involved in this fire indicates that its rapid spread beneath the pier deck and the resultant large loss were directly or indirectly due to the following four conditions:

1. Combustible construction beneath the pier deck.
2. No automatic or open sprinklers, automatic fire alarm or other means of protection under the pier deck.
3. Inaccessibility of area for fire fighting.
4. No subdivision by firewalls, bulkheads or other means for restricting spread of fire.

The N.F.P.A. Regulations for the Construction and Protection of Piers and Wharves permit combustible construction beneath the pier deck,

but require bulkheads or fire walls for the purpose of limiting possible fire areas and provide for hatchways to be located at intervals along the pier deck, and openings for revolving nozzles, cellar pipes, etc., for use by the fire department in event of fire. Had the Rhode Island State Pier complied with these requirements, it seems probable that the recent fire would have been confined to a relatively small area beneath the pier deck and the loss would have been insignificant in comparison to the value involved.

Oakland Horse Show Fire.

By Clarence Heller,
(Member N.F.P.A.)

A horse show, which was held in the Auditorium of Oakland, California, terminated Saturday night, February 7, 1931. Some of the horses were removed the following day, but 66 remained in the temporary stables erected adjacent to the steel frame Auditorium building when fire was discovered shortly before two o'clock Monday morning. Four men and 50 horses were burned to death. The property loss was in excess of $500,000, exclusive of the buildings, which were valued at $10,000 and were a total loss.

Property Involved.

These stables were erected on a vacant lot by the Oakland Horse Show Association under a permit from the City of Oakland. They consisted of six wooden sheds, each 30 feet wide by about 190 feet long. Their walls were 2 ft. 6 in. apart, but the roofs of adjacent sheds joined in a common gutter. They were built of rough boards, 1 in. x 12 in., placed vertically. The roof was also of boards covered with tar paper nailed down with wood lath. Each shed had a central passageway 12 feet wide with stalls on either side 9 feet deep.

The floors of the aisles were covered with wood shavings, and straw covered the floors of the stalls. Adjoining some of the box stalls were small rooms in which blankets, trophies, and other paraphernalia were kept, and in which some of the attendants slept. There were no windows or skylights in the buildings. The only doors were at each end of the passageways. These were double doors, the entire width of the aisle, and were the only means of egress from the buildings. Had there been glass panels in the doors the light of a fire would have been visible at night to the watchman, or other passers-by.

In addition to the flammable material on the floor, bunting and other decorative cloth materials were suspended from the rafters. The sheds were without ceilings, and without divisions other than the rough lumber between stalls, which in most cases were not of full height. Ample space was available to have permitted separating the sheds, which would have made each accessible on all sides and would have practically assured the prevention of a total loss.

International.

Four men and fifty horses were burned to death in a fire originating in stables of the Oakland, Cal., horse show on Feb. 7, 1931.

Fire Protection.

A few 2½-gallon chemical extinguishers are said to have been in some of the sheds. Otherwise they were without fire extinguishing equipment of any kind. The only water supply inside the structure was from a 1-inch pipe to which a ½-inch tap was attached in each shed for the purpose of filling buckets to water the horses. There was one single outlet street hydrant at the northwest corner of the building, which was supplied from a 4-inch main. There were other hydrants supplied by large mains under 80 pounds pressure, but they were 500 feet or more from the structure.

A 2½-inch hose was connected to the street hydrant at the stables and was kept charged. To this hose four 1½-inch lines were attached and brought close to the building. This gave sufficient water for incipient fires, but if a fire got beyond that stage the supply from one hydrant was insufficient and additional water supplies were subject to the delay and reduction of pressure from long leads. In addition to outside lines a charged line of pipe or large hose should have been placed along the entire front and back of the stables, and to it there should have been attached valves with 100 feet of hose inside each end of each shed. The Fire Department also installed a hose wagon with three men near the Auditorium.

Two city fire alarm boxes were within 60 feet of the buildings. The Horse Show management employed a night watchman. He was 80 years old, did not carry a clock, and apparently was under little or no supervision. While the Horse Show was in session the Oakland Fire Department had six men patrolling the Auditorium and the various buildings in which the horses were housed. This patrol, however, was discontinued when the Show closed.

"No Smoking" signs were displayed, but it was impossible to enforce such regulations. It has been definitely established that smoking did take place in

the stables, both when they were under guard of the firemen and thereafter. After the Show, supervision was relaxed, notwithstanding that the hazard continued as long as the buildings were occupied by men and animals. There had been a fire a few nights previous at about the same hour. It was discovered promptly and extinguished, indicating that had closer inspection continued the last fire would not have reached such extensive proportions.

Story of the Fire.

Fire was discovered by the watchman near the center of the structure, but probably not until after it had been burning for some time. It is said that the shed in which it occurred was then unoccupied. The watchman ran to the temporary fire station not more than one hundred feet away and roused the three firemen who were asleep. One of the latter pulled a fire alarm box. The delay in the discovery of the fire by the watchman and the fact that the firemen on duty were asleep, resulted in so much time lost that the flames were beyond control when reinforcements arrived. Even had the stables been of fire-resistive construction the occupancy and character of the people who used them were such that with no better fire protection and supervision similar results on a reduced scale could have been expected.

In addition to the smoking, considerable drinking is reported to have taken place on the night of the fire, so that the direct cause of loss of human life is uncertain. As soon as the fire got underway there was a great deal of noise and commotion, so that every person should easily have wakened and had time to escape. Many of the grooms made heroic attempts to save the horses in their charge, and some no doubt sacrificed their lives in attempting to rescue the fear-stricken horses.

But whether smoking, or incendiarism as is suspected by some, was the cause of the fire is of secondary consideration. When the sensational features are disposed of, the plain facts are that a large number of animals of great value and capable of intense suffering as well as their human attendants were housed in a tinder box structure without any form of automatic alarm or other inside protective system, and without adequate inspection or supervision. The building and its contents presented not a usual, but an extraordinary hazard which it did not take an expert to recognize, but extraordinary precautions were not taken to prevent or combat a fire which could easily have been foreseen.

Four Apartment Building Fires.

In the period of approximately six weeks between the last of January and the middle of March, 1931, four apartment building fires have occurred in widely separated parts of the United States, each involving a considerable property loss and one involving a loss of three lives. These fires occurred in New York City, Stockton, Cal., St. Paul, Minn., and Lynn, Mass., the first on January 31, and the last on March 18.

These fires are of particular interest because they are typical of the type of fires which may be expected in buildings of this class of construction and occupancy. Moreover, the buildings involved are, unfortunately, typical of the class in all parts of the United States. They were of apparently substantial exterior construction, but with highly combustible interior construction and contents. Three of them were at least thirty years old, while one was a modern structure erected less than three years ago. In each instance the fire was of insignificant origin and might have been readily extinguished at the start.

In construction the three older structures had substantial brick exterior walls, but were of frame construction throughout their interior, including wood beams, joists and studding. The newer structure had brick exterior walls with unprotected steel frame with wood floor joists and studding. Two of these buildings had a considerable number of interior partitions of wall board, one had metal lath and plaster, and in the other wood lath and plaster predominated. The effect of the fire in each was similar.

Unprotected vertical and horizontal openings existed in all four cases, and in each instance such openings were a factor in the rapid spread of the fire upward and laterally. In at least one instance the fire might have been confined to the basement had protection been afforded the vertical openings leading therefrom.

None of these buildings were equipped with automatic sprinklers or automatic fire alarms. Had sprinklers been installed, there seems but little doubt that they would have been effective in extinguishing and controlling the fire at the start and confining it to the point of origin. This is borne out by the sprinkler fire record of the N.F.P.A. covering hotels and apartment houses as follows:

Effect of Sprinklers—Hotels and Apartments.

	No. Fires	%
Extinguished fire	170	83.0
Held fire in check	33	16.0
Total	203	99.0
Unsatisfactory	2	1.0
Total	205	100.0

All of these fires were controlled by the opening of ten or less sprinkler heads, and most of them by two or less. An automatic fire alarm, which would have detected the fire before it gained headway, would, in the absence of sprinklers, have probably prevented the loss of life in the Lynn fire and given warning to the fire department in the case of the New York fire long before the entire room of origin was a mass of flames.

Lincoln Square Arcade Building, New York.

Report by New York Board of Fire Underwriters, (Member N.F.P.A.).

The Lincoln Square Arcade Building, a large New York apartment house of brick and frame construction at Broadway and Sixty-fifth Street, was damaged by fire to the extent of more than $450,000 on January 29, 1931. A particular feature of this fire was the unusual and extremely large amount of fire department personnel and equipment required to subdue it. The large loss was primarily due to the inferior construction of the building, the large amount of combustible contents, and lack of automatic sprinklers or other suitable private fire protection.

Construction and Occupancy.

The building was six stories and basement in height, of ordinary brick construction, erected about 1906, and covered an area of 21,750 sq. ft. The height and area for such type of building was excessive. It was divided into two sections by a 15-foot wide arcade, extending east and west. This arcade was one story high, and above it there was an open court with large thin glass windows in the arcade walls, facing each other across the court. The two sections communicated with each other on all floors above the first across the arcade court by metal enclosed bridges, having openings at each end with wooden doors and thin glass panels.

All walls were of brick and independent. Those of the arcade were supported above the first floor on unprotected steel beams and iron columns. Finish was largely plaster on wood furring. Partitions were in part lath and plaster on wood studs, but the major number of partitions consisted of compressed paper board on wood studs. These partitions formed numerous small rooms and sections. The floors were chiefly single wood boards joisted, and supported on wood girders and posts. The cornice was metal. Skylights were numerous and of wired glass with metal frames. Ceilings were mostly metal.

There was one stairway in each section, enclosed in part by the building wall, in part by three-inch plaster blocks and in part by plaster on wood lath and studs. Thin glass skylights were provided over the stairways, and there were unprotected openings on all floors to large hallways. There was one elevator in each section, enclosed on three sides by plaster blocks and on the fourth side having open iron grille doors to stairs and hallways. The stairways encircled the elevator shafts.

The building had a multiple occupancy. The lower floors contained retail stores, restaurants, barber shop, laundry and other mercantile or light manufacturing occupancies. There was also an entrance section through the arcade to an adjacent theatre building. The three upper floors were occupied as dwelling apartments or studios. The diversified character of the occupancy of the building is said to have been permitted because the structure was erected prior to the enactment of the present laws, which now require a certificate of occupancy from the Superintendent of Buildings.

International.

The Lincoln Square Arcade Building fire at its height. Originating on the third floor in a chemist's laboratory, the fire spread rapidly through the upper floors, which were completely gutted.

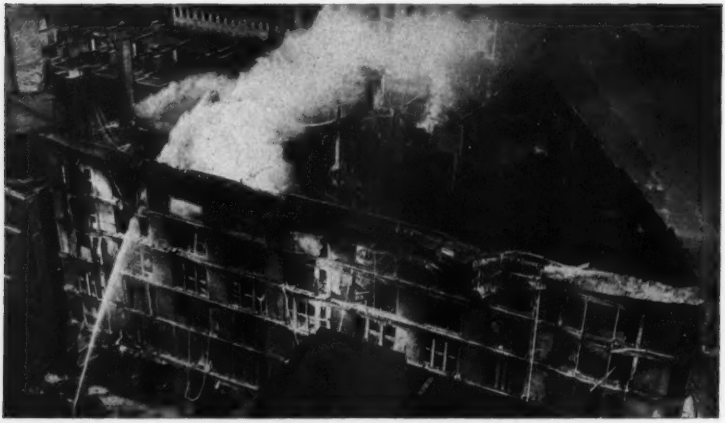
Story of the Fire.

The fire originated from a cause not determined in a room on the third floor of the north section occupied by Maurice W. Schwarz, a consulting chemist. These premises had been occupied by Mr. Schwarz approximately three years, he having taken the business over from a previous tenant, who, in turn, had been located there a similar period of time.

Mr. Schwarz states that he closed and locked his laboratory at 5:30 P.M. after extinguishing all lights and leaving everything in order as was his custom. He states that he had been making an analysis during the afternoon, but had used nothing of a combustible nature. Four bunsen burners used in the analysis had been extinguished. An investigation by the fire marshal, so far as concluded, does not indicate that there was anything of a suspicious nature about the origin of the fire.

Discovery and Alarm.

The fire was discovered by a taxicab chauffeur while he was leaning upon a fender of his cab parked on the east side of Columbus Avenue near 65th Street. This chauffeur reports that he saw smoke seeping through a third floor window on the Broadway front. He sent in an alarm to the fire department from a box at the corner of West 66th Street and Columbus Avenue. A few minutes later this window was blown out and flames lapped up the front of the building.



International.

A view of the Lincoln Square Arcade Building, New York, showing the complete destruction of the apartments and studios on the three upper floors. Inferior construction and combustible contents were factors in the large loss which resulted from this fire.

The first alarm was sounded at 11:50 P.M. and was followed within the next thirty minutes by second, third, fourth and fifth alarms. By one o'clock the fire had reached such proportions that the fire department felt that to protect surrounding property additional equipment was necessary, and consequently a "9-9" alarm was sounded at 1:11 A.M.—the first in twenty years. A total of 35 engine, 10 truck, 3 water tower and one rescue companies responded to the alarms. This represented approximately 50% of the Manhattan engine companies and about 20% of the entire city fire department.

The fire spread rapidly through the front part of the third floor in the section in which it originated and to the fourth, fifth, sixth floors and roof of both sections of the building. These floors with their contents, together with the entire roof, were almost completely destroyed, resulting in a complete devastation of the upper half of the building. A portion of the second floor collapsed and severe smoke and water damage resulted to the lower floor. The fire also extended to the window casings on the sixth floor of No. 116-118 West 65th Street, an exposed building across the street.

A number of firemen fighting the fire on the fourth floor were injured when they were hurled to the second floor of the building when a stairway collapsed. All the tenants escaped without injury, but were able to save but few of their personal effects.

The total loss to the building is estimated at $200,000. The loss to contents was heavy and is also estimated at approximately $200,000. Rent insurance amounting to $140,000 was carried by the owners of the building and the loss on rents has been estimated at about 50%.

Conclusions.

The magnitude of this fire is attributable to the poor construction of the building and the large amount of combustible material it contained. The absence of proper stair and elevator enclosures, the thin glass windows in the arcade court walls and the compressed paper-board partitioning, all contributed toward a rapidly spreading fire. The excessive height for a building of this type of construction together with its large area, cut into numerous rooms and units by partitions of a readily combustible nature, made the fire difficult to extinguish. Hose streams directed into the building were broken up or diverted by the partitions long before they reached the seat of the fire in the interior and permitted the fire to reach serious proportions with respect to adjacent property.

The call for the large amount of fire department apparatus and personnel to fight the fire is primarily attributed by the fire department to the need of protection to surrounding property.

Eden Square Apartments, Stockton, Cal.

Report by Stockton Fire Fighters Relief Association, (Member N.F.P.A.).

The Eden Square Apartments, Stockton's finest apartment house, was destroyed by fire late Saturday evening, January 31, 1931, in the most spectacular blaze that has occurred in the city for a number of years. Although the outside walls are still standing, the interior of the building was so badly gutted that it will probably have to be razed.

Construction and Occupancy.

The building was erected in 1928 at a cost of more than $350,000 and was considered one of the finest and most modern apartment buildings in the state. It was six stories in height and contained 40 apartments, a roof garden, restaurant, pharmacy, beauty shop and grocery store. The annex, which was but little damaged by the fire, contained a garage and offices.

The exterior walls were of brick and the structure was of steel frame construction. The floor beams were 2 in. x 14 in. and the studding 2 in. x 6 in. Metal lath and plaster were used throughout. Floors were of wood. The basement was subdivided by hollow tile partitions. An elevator and light well ran from the basement to the roof.

Private fire protection in the building consisted of a 4-inch standpipe connected to city mains extending from the first to the top floor. There was a hose outlet on each floor with 50 feet of $2\frac{1}{2}$-inch. hose attached.

Story of the Fire.

At about ten o'clock on the evening of January 31 one of the proprietors of the Eden Square Pharmacy, located in the building, detected the odor of smoke coming from the basement. He called the hotel manager, who, with the night man from the adjacent garage and the night watchman, then went

to the basement. They found a fire burning in the incinerator room in some waste paper, presumably caused by a carelessly thrown cigarette. The blaze was quelled by hand fire extinguishers and they declared later that they pulled boards away from the point at which they found the blaze and made sure that no fire was left.

A careful survey was made of the entire basement and nothing found amiss. An officer of the fire department was called who, when told that the fire had been extinguished and a careful check made, promised to investigate the affair thoroughly in the morning to determine if the fire might have been of incendiary origin.

Shortly after 11:00 P.M. flames were again discovered in the basement under the Piggly Wiggly store. An alarm was immediately sounded which was received by the fire department at 11:14 P.M. This was followed at 11:19 P.M. by a second alarm and at 11:57 P.M. by a third alarm. At the start the fire seemed insignificant and the first intimation that many of the tenants had that anything was amiss was when they heard the apparatus pull up in front of the building. The fire appeared to be confined to the basement and the upper floors did not seem in any way endangered.

The attack on the blaze in the basement was started from three sides of the building. No sooner had the firemen gotten to work than they were assailed by ammonia fumes from the building's cooling system located in the basement. This proved something of a handicap. In the meantime, the flames, apparently extinguished in one place, broke out in others. Several times the firemen appeared to be getting the upper hand, only to see their work undone as the fire worked through floors and partitions.

Shortly after one o'clock the fire spread upward by way of an elevator shaft and light well, and ignited the roof. The ladder pipe on the fire department's aerial ladder was brought into play and for a time appeared to be holding the fire on the roof. Each time it was shifted to a new location, however, the place it had just left broke out anew.

Apartments on the west side of the building were the first to be attacked by the fire. The fire reached these by way of unprotected openings in a service elevator shaft. Five streams of water were directed on the fire at this point from the roof of a building adjoining on Acacia Street. Other firemen directed streams from an alleyway and fire escape in the rear.

It was here that several of them were hurt when, without warning, a large section of the building's cornice broke away and fell to the street, carrying with it part of the railing of a fire escape from which a detail of firemen were operating a hose stream. The bricks and terra cotta struck a large tree in the alleyway, snapping it off like a match. Warned by the roar of the falling débris, the firemen jumped for safety as best they could, but two of them were seriously injured.

V. Covert Martin.

The Eden Square Apartments, Stockton, Cal., after the fire which swept it from basement to roof. Unprotected openings permitted an apparently insignificant blaze to gain rapid headway and spread to all portions of the structure.

By two o'clock it was apparent that the building was doomed, and a number of tenants, eluding the vigilance of the police and firemen, attempted to return to their apartments to salvage their personal effects. They were driven back by the smoke and flames, which by this time filled the structure.

That the fire did not result in loss of life is due in a large measure to the efforts of the son of the garage proprietor, who rushed through the upper part of the building pounding on doors and rousing the occupants. Many of them had slept through the noise and confusion incident to the arrival of the fire department. One woman, in the excitement of leaving the building, entered the elevator and presumably pushed the button for the basement. The elevator accordingly went to the basement, which was a mass of flames. Terrified, she pressed the first floor button and the elevator started up, got almost to the first floor and stuck. Another tenant, noting the situation, smashed the door of the elevator shaft and succeeded in hauling the woman to safety.

The fire completely gutted the entire building and the intense heat caused the steel work to buckle, permitting the floors and roof to fall. The loss to the building was estimated at $201,000 and that to the contents was thought to be well over $100,000.

V. Covert Martin.

Unprotected steel framework in Eden Square Apartments, Stockton, Cal. Heat from the fire sweeping through the building caused these steel members to buckle, precipitating the upper floors and roof on to those below and weakening the exterior walls.

Conclusions.

This fire again points out the fire hazard of modern buildings assumed by the general public to be relatively safe from fire. Combustible interior construction and contents, coupled with unprotected openings, furnishing a pathway for the rapid spread of flames, created an intensely hot fire. This heat caused the steel members to fail, precipitating the upper floors and roof on to those below and weakening the exterior walls.

Automatic sprinkler protection in the basement and in all vertical openings would have probably held the fire to the point of origin and prevented its spread to the upper portions of the building.

Anthony Apartments, St. Paul.

Report by John Townsend, Jr.,
(Member N.F.P.A.).*

A carelessly dropped cigarette or match in a storeroom in the sub-basement of the Anthony Apartments is thought to have caused the fire that destroyed the west section of this building in St. Paul, Minn., on February 9, 1931.

Construction and Occupancy.

The Anthony Apartments were built about 40 years ago and consisted of five sections, each section being four stories in height with basement and sub-basement. These sections were built together in front, but a narrow area way about 8 feet wide divided them at the rear, starting at a point about 30 feet from the front (see diagram). The front sections were divided by a fire wall that ended with a 2-foot parapet on the roof. The floors were wood on 2-in. x 12-in. wood joists, the roof was tar and gravel on 2-in. planking supported by 2-in. x 12-in. wood joists, with an air space of 4 ft. over the ceiling of each section. There was an open stairway from the basement to the fourth floor in each section in the front part of the building, and in the rear wooden porches and steps had been built on the outside of the building from the ground to the fourth floor. The walls were sandstone up to the second floor and brick veneer from there up.

Each section had been divided into two apartments by a partition of 2 x 4's covered with wall board, *i.e.*, there were two apartments of five rooms each on each floor of each section. Originally there had been a dumb waiter shaft in the rear of each section about 6 ft. square running from the sub-basement to the fourth floor, but subsequently closets had been built in this shaft on each floor. There was, however, a 6-in. space back of the wall of each closet, which formed a perfect flue from the basement to roof. The plumbing was of the old style and there were large openings running from floor to floor where the pipes went through. These openings had been boxed in but had not been cut off vertically. The windows were ordinary double strength glass in wooden frames and were a factor in the spread of fire from one section to the other. In the sub-basement there were large openings in the fire walls through which the steam pipes passed from one section to the next.

The management of the building was fairly good and the owners did all they could to reduce the fire hazard by keeping the premises clean and safeguarding the heating arrangements; each tenant was furnished a storeroom to store their excess furniture and of course the manager had no jurisdiction over these rooms. Each floor of each apartment was provided with a fire extinguisher.

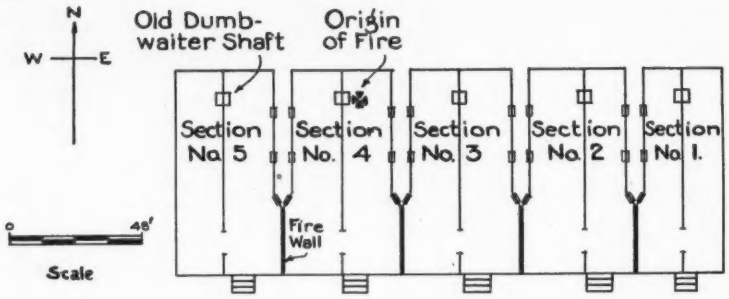


Diagram of Anthony Apartments, St. Paul, Minn., showing general plan of building and point of origin and factors in rapid spread of fire.

Story of the Fire.

The fire was first discovered by the occupants of the basement apartment in Section 4, who noticed smoke coming from the walls of the closet built in the shaft. They informed the telephone operator of the building and she in turn sent in the alarm of fire, which was received by the fire department at 11:05 A.M. In the meantime the janitor and the engineer chopped away part of the closet wall and tried to extinguish the fire, but it had gotten up the shaft and they were soon forced out of the basement by the heat and smoke. The telephone operator deserves a great deal of credit, for she stuck to her post, calling all the apartments and warning the occupants of their danger. She was almost overcome by smoke before she left.

Two engine companies, one truck company, one squad, a district chief and the fire insurance patrol responded on the first alarm. Lines of hose were laid and the firemen tried to get into the basement where the fire had originated, but were forced out. They also tried to get in on the first floor of Section 4 to prevent the fire from going up between the walls, but were unsuccessful. Hose streams were then directed on to the fire through the basement door and windows. In the meantime the truck company saw to it that everyone was out of the section where the fire started.

A special call was sent in at 11:15 A.M. calling out two more engine companies and one more truck. When the roof of the fourth section was ventilated the flames came through at once, showing that the fire had swept through the entire building. An attempt was made to cut off the third and fifth sections, but the firemen were forced out by the flames, which had gained entrance through the fire walls in the sub-basement by way of the holes provided for the steam pipes and spread upward through the old dumb waiter shaft. The

St. Paul Daily News.

Fire in the Anthony Apartments, St. Paul, Minn. Fifteen minutes after its discovery this fire had traveled from the sub-basement to the roof by means of an old dumb waiter shaft which had been partially blocked off.

fire also spread through the windows across the 8 ft. areaway. Lines of hose were carried up the rear stairs from the outside and streams were played on the fire from the rear doors and windows.

Another special call was sent in at 11:27 A.M. calling out five more engine companies and two more truck companies, and the off-shift of firemen. About 150 responded by 12:00 M. By this time the fire in Section 3 had been checked enough so that lines of hose could be taken into this section and the fire attacked through the windows across the areaway. At 12:14 P.M. a fourth call was sent in for three more engine companies. The fire was under control by 4 P.M., but several engine companies were kept there until noon the next day to prevent any rekindling.

An investigation revealed that the fire started in one of the storage rooms in the sub-basement of Section 4, probably from a carelessly disposed match or cigarette, and extended up the dumb waiter shaft to the roof, where it mushroomed out and burned down through the ceiling. It also traveled through the fire walls in the sub-basement by means of the openings for the steam pipes and communicated through the windows on practically all floors from Section 4 to Sections 3 and 5. The boxed-in plumbing was also a factor in the spread of the fire. The wall board partitions in each section probably burned away in the early stages of the fire.

After the fire it was found that the roof had fallen in on Sections 3, 4 and 5, and the first floor and floor of the basement in these sections had col-

lapsed. The wind was in a westerly direction but not strong enough to carry sparks any distance. The temperature was near zero, which somewhat hindered the firemen in their work, as the lines kept freezing to the ground and made them hard to shift from one position to another, and it also covered the rear steps and porches with ice, which made footing very insecure.

There was no loss of life, due largely to the fact that the fire occurred in the daytime. The fire insurance patrol was able to cover some of the contents in the buildings and loaned covers to the owners to protect such property as they were able to salvage after the fire.

The total loss to the building was estimated at $110,723, divided as follows:

Section 1	$800.00
Section 2	1,131.40
Section 3	22,791.67
Section 4	43,000.00
Section 5	43,000.00
	$110,723.07

The apartments were all furnished by the building owners, the loss on which amounted to about $9000. This brought the total loss from this fire to $119,723.

Conclusions.

This fire is an excellent example of how quickly fire can spread by way of unprotected vertical openings even in the daytime, when people are about, and reasonably prompt discovery is made. In this case the fire spread from the sub-basement to the roof in about fifteen minutes.

Hotel Lenox Fire, Lynn, Mass.

Report by H. S. Walker,
(Field Engineer, N.F.P.A.)

Three persons were burned to death and the Hotel Lenox, an apartment hotel in the central section of Lynn, Mass., was totally destroyed in a fire which occurred shortly after four o'clock on the morning of March 18, 1931. Forty-three other guests escaped by means of fire escapes and life nets held by firemen. All stairways were cut off by flames. Combustible interior construction and unprotected vertical openings were factors in the rapid spread of the fire from a miniature golf course in the basement to the upper floors occupied by transient and permanent guests.

Construction and Occupancy.

The Hotel Lenox was a five-story structure with brick exterior walls and wooden interior. It was located at the junction of two important thoroughfares, having a frontage of approximately 150 feet on Exchange Street and 100 feet on Broad Street. The building was erected in 1889, but its interior had been altered and rebuilt several times—the last alteration being made in

International.

Aerial view of the Hotel Lenox, Lynn, Mass., after the fire of March 18, 1931, which swept it from basement to roof, with a loss of three lives and a property damage amounting to more than $150,000. Starting with an insignificant blaze in a miniature golf course in the basement, this fire could easily have been checked by the operation of a single sprinkler head.

1928. The brick walls were said to have been particularly well constructed, which probably accounts for the fact that they remained in place after the supports inside the building burned away. An unused dumb waiter shaft extended from the basement to the roof. There were two open stairways leading from the street level to the upper floors. One of these stairways was said to have been provided above the second floor with gates which were kept locked to prevent transient guests from departing without paying their bills. The latter fact, although a serious matter from the standpoint of life safety, does not seem to have been an important factor in this fire. A light shaft extended from the third floor to the roof.

The building was not equipped with automatic sprinklers. Private protection for life and property consisted of a single 2½-in. standpipe with one 50 ft. length of linen hose on each floor, two 2½-gallon soda-acid extinguishers on each floor, and one 2½-gallon soda-acid extinguisher in each store on the street floor.

Somewhat offsetting the inadequate fire protection, the building was unusually well provided with fire escapes. This was due to the efforts of the state building inspector, who ordered them constructed in 1914 in spite of bitter opposition. On the front of the building on both streets every window on the third, fourth and fifth floors opened on to a fire escape which ran

along the entire front of the structure with stairs at either end. These stairs terminated at the second floor, where a collapsible iron ladder was provided leading to the street. A similar fire escape was provided in the rear on the Broad Street side. The rear of the Exchange Street side was not so equipped, nor were there any means of escape from the second floor other than by the stairways or the fire escape ladders, the latter available only from a single window at the extreme ends of the building.

The building was occupied on the street floor by various stores and the hotel office. On the second floor were a dentist's office, an optician, a beauty parlor, and other similar occupancies. The three upper floors were used for hotel purposes and consisted of single rooms and apartments. There was a banquet hall in the building but no dining room. Most of the guests were so-called "permanent" guests, but rooms were available for a few transients. The hotel was listed as having approximately 100 guest rooms. A miniature golf course occupied part of the basement.

Story of the Fire.

The fire was discovered by the night clerk at about 4:20 A.M., when he went to the basement to take care of the heater. The section occupied by the golf course was separated from the rest of the basement by a door having a glass panel, and it was through this panel that the clerk observed the fire. He had no key to the room and returned upstairs without ascertaining the extent of the fire. He is said to have sounded the fire gongs in the hotel corridors, called some of the guests from the switchboard, and notified the fire department by telephone. This call was received by the fire department at 4:27 A.M., and an engine company, a ladder company and a chemical company located within a quarter of a mile were at once dispatched.

At about the same time a police officer passing in the street discovered the fire and sounded an alarm from the fire alarm box opposite the building just as the companies responding to the telephone call arrived. After sounding the alarm, the officer entered the hotel lobby and with the night clerk went into the elevator to go to the upper floors and assist the guests in getting out. When they reached the third floor the smoke and flames drove them back.

The fire spread with incredible rapidity (probably by means of the dumb waiter shaft), cutting off all escape by the corridors and the stairways at the start. Firemen arriving on the first alarm attempted to enter by way of the main stairway from the street but were unable to get beyond the doorway. The combustible construction and contents made ready fuel for the flames and within fifteen minutes of the arrival of the firemen the fire was all through the building and coming through the roof.

Most of the guests in the front of the building made their escape by way of the fire escapes. Two on the second floor were taken down a ladder by

Frank Colby, Boston Transcript.

Offsetting to some extent the lack of adequate private fire protection, the Hotel Lenox, in Lynn, Mass., was unusually well provided with fire escapes. Note escapes extending along entire front of building on three upper floors.

firemen. Some of those in the rear used the fire escapes, others were taken down ladders, while six jumped into a life net held by firemen. This life net caught fire from brands before the last man jumped into it. The three who lost their lives apparently either left their rooms and went into the corridors, where they were met by a hot blast of smoke and flame and were overcome and burned before they could reach the windows and safety, or were awakened too late to escape. The fact that the bodies were found near the doors of their respective rooms and the statement that at least one of them had been seen in the corridor would seem to bear out this theory. Indicative of the rapid spread of fire through the corridors was the experience of one of the occupants of a rear room on the fourth floor who had to cross the corridor to make his way to a fire escape and burned his hand on the door knob of the room from which the fire escape led.

Additional alarms were sounded in quick succession, calling out the entire Lynn fire department and companies from Revere and Swampscott. In all, thirteen engine, five ladder, three chemical and one salvage companies were engaged at the fire, while apparatus and men from Salem, Peabody, Revere and Marblehead covered in at Lynn or Swampscott stations under the mutual aid plan. Hose streams, including three deck guns, two deluge sets and two

ladder pipes were used from every vantage point, but little could be done other than to confine the fire to the hotel building, which was practically destroyed. Flying sparks and brands were carried by a brisk wind for a considerable distance over a frame residential and light manufacturing district. A serious conflagration might have resulted had it not been for snow which covered the roofs and gutters.

Some criticism was directed at the apparent failure of the iron ladders, leading from the fire escape at the second floor level to the ground, to function properly. These were tested after the fire and found to be in working condition. It seems probable that in the excitement the release pin was not removed and that the ladders failed to drop. The failure of these ladders was not a serious factor in the exit of the guests from the building, for the fire department provided short ladders extending from the street to the escapes on both sides of the building. Ladders would have been provided at these points by the fire department, anyway, for the narrow iron ladder close to the brick wall offered insecure foothold for the rush of people using the escape.

The cause of the fire is thought to have been the careless disposition of a cigarette in the premises of the miniature golf course. The fire apparently traveled upward and across the ceiling of the basement until it reached a shaft through which it could travel upward. It spread rapidly into the upper corridors, and at the same time mushroomed under the main stairway, cutting off all escape by this means almost at the start. At the same time, there was but little fire damage to any of the stores on the first floor or in the basement itself.

The total loss was estimated at around $150,000. Very little of salvage value was left. Due to the interior condition of the building it was deemed advisable to condemn the entire structure, and the city building inspector ordered the structure razed.

Conclusions.

This fire is just one more example of what can happen to a building which from outward appearances is apparently of substantial construction. Old and thoroughly dry, the highly combustible interior and contents are ready fuel for a fire once it gains a little headway.

This fire, apparently of an insignificant nature at the start, could easily have been extinguished had the building been equipped with automatic sprinklers. It seems likely that even a night watchman making regular rounds throughout all portions of the building might have detected it before it gained much headway. The fire department has consistently recommended sprinklers for buildings of this type for a number of years, which recommendations have been put aside or been entirely ignored. Vertical openings should be protected, in any event, but where the use of such openings or shafts has been discontinued they should be adequately fire-stopped.

Church Fires in Ontario and Quebec.

Three large loss church fires occurring in Ottawa and Montreal between the last of December and the middle of February have again called attention to the fire record of churches in general and more particularly those of the provinces of Ontario and Quebec. The three recent fires are those occurring in the St. Joseph's Catholic Church at Ottawa, the St. Denis Church at Montreal and the St. Jean Baptiste Church at Ottawa. A brief description of these fires taken from Press reports follows:

St. Joseph's Church, Ottawa.

This fire occurred on December 27, 1930, when a tray of candles was upset by a small boy worshipper. The lighted tapers set fire to a manger depicting the nativity of the Saviour and from here spread to the evergreen decorations which lined the interior of the church.

Priests, summoned by three women who had been engaged in their devotions, risked their lives to rescue sacred vessels and relics. Firemen fought desperately to save the building, but were successful only to the extent of preventing the spread of the flames to a recently constructed rectory valued at about $75,000. The church structure, which was valued at $450,000, was totally destroyed.

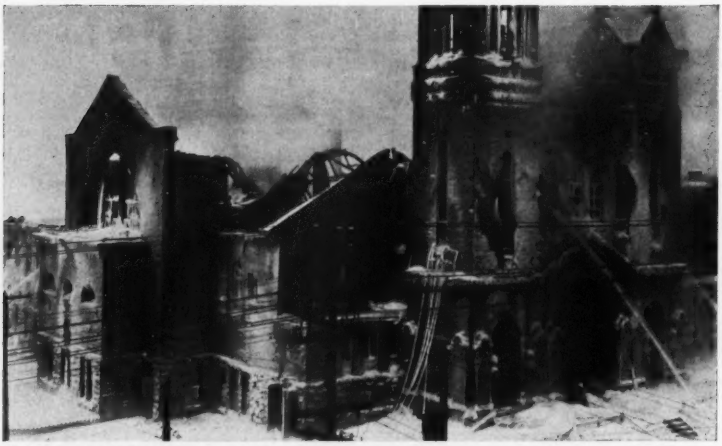
International.

The upsetting of a tray of candles by a small boy worshipper was the cause of the fire which destroyed St. Joseph's Church in Ottawa, with a loss of over $400,000 on Dec. 27, 1930.

St. Denis Church, Montreal.

A fire of undetermined origin destroyed the St. Denis Church in Montreal at 12:35 A.M. on January 29, 1931. The fire originated in the basement of the church beneath the sacristy and sweeping up the rear partitions spread across the roof space to the front of the church.

The fire was discovered by the parish priest, who smelled smoke entering his house (which adjoined the church) through an open window. He glanced out and saw smoke coming from the church. Hastily dressing, he rushed into the building in order to save the Sacred Host, but due to the dense smoke which filled the interior of the church, he was unable to do so. He rushed to a near-by fire alarm box and sent in an alarm to the Fire Department. On their arrival additional alarms were sounded.



La Presse, Montreal.

Originating in the basement during the early morning hours, this fire in the St. Denis Church, Montreal, had gained such headway before discovery, that it was impossible to enter the building to save the sacred relics.

When the firemen entered the building they found it full of smoke and flame and in spite of their efforts the fire continued to make headway. At two o'clock flames burst through the roof and shortly after some of the masonry fell, severely injuring two of the firemen fighting the fire inside of the building. Sparks and brands threatened the presbytery adjoining the church as well as a number of dwellings. Firemen were stationed at various points to take care of this situation.

The church was erected in 1899 and was valued at $300,000. The loss was practically total.

St. Jean Baptiste Church, Ottawa.

Ottawa's second large church fire occurred early on the morning of February 8, 1931, when the St. Jean Baptiste Church was destroyed by fire of unknown origin. Situated on a promontory, in the western section, the blazing church could be seen from all parts of the city.

The fire was discovered shortly before 3:00 A.M. by priests who were at their devotions. In less than two hours the entire interior of the church had been swept by the flames and only the exterior walls of brick remained. A seminary of the Dominican Order, adjoining the church, was also destroyed. The sacred vessels were saved, but a gold altar valued at $25,000 was entirely ruined.

Fire apparatus from all parts of the city responded to the alarm, but handicapped by sub-zero temperatures and the open combustible construction of the interior of the building, they could do but little to impede the progress of the fire through the structure.

International.

All that remained of the St. Jean Baptiste Church at Ottawa were the solid brick exterior walls. The interior, of wooden construction throughout, was entirely destroyed.

The total loss to the church was estimated at $250,000 and to the convent adjoining at $150,000.

Fire Record of Ontario and Quebec Churches.

The files of the Department of Fire Record of the National Fire Protection Association contain reports on sixty fires which have occurred in churches in the provinces of Ontario and Quebec during the period from January 1, 1920, to April 1, 1931.

The record is by no means complete and does not include many of the small fires which have occurred from day to day in church properties. The reports from insurance inspection organizations, which are the principal source of data on fires in industrial properties, are found in comparatively small number in the church fire record classification. Many of the reports are based on newspaper accounts which have been verified by local N.F.P.A. members.

In view of the character of the original data, which include the larger and more important fires but not a fair proportion of the smaller fires, this record may not be completely representative. It is, however, significant in that the fires here recorded for a period of ten years represent an aggregate loss of more than five million dollars.

The causes of these church fires are shown in the following table. It is interesting to note that the number of different causes are relatively few, indicating that if attention is given to these items a large number of church fires may be prevented.

Causes of Ontario and Quebec Church Fires.

Cause	No. Fires
Overheated furnace or pipes	8
Defective wiring	6
Defective wiring—organ	2
Candles	5
Exposure	3
Forest fire	2
Incendiary	2
Other known causes	4
Total known causes	32
Unknown causes	28
	60

It is not surprising that the fires due to the heating plant in churches should be frequent, because of the conditions under which they are used. An adequate heating plant is not always provided, necessitating forcing the plant on extremely cold days, which frequently causes overheating and results in fire.

"Defective wiring" as a fire cause is always open to question. In one or two fires in this record in which this cause was assigned there is some doubt as to whether or not that was the actual cause. Fires starting in the electric wiring of organs are, however, better authenticated.

Other causes listed in the table are self-explanatory. From a study of the facts surrounding some of the fires attributed to unknown causes it seems fairly certain that some of these were due to heating plants, while others may rightly have been due to inferior wiring.

The amount of loss in the church fires contained in this record is given in the following table:

Analysis of Loss.

	No. Fires
Over $100,000	17
$10,000—$100,000	34
$5,000—$10,000	7
Less than $5,000	1
Large loss, no exact data	1
	60

These large losses were for the most part due to the construction of the buildings involved, which were usually of large area with an opportunity for the fire to get into the roof space or open loft above the auditorium, which is practically inaccessible to the fire department.

Automatic Sprinkler Protection.

A forward step providing for adequate private protection has recently been taken in Quebec by those in charge of several large church properties. This is the application of automatic sprinkler protection to this class of buildings. Automatic sprinkler protection for any type of occupancy is the surest safeguard for life and property and its application to churches is a progressive step.

La Presse, a Montreal newspaper, has recently featured the sprinkler installation at the Notre Dame Church in Montreal and the Province of Quebec Safety League has sponsored talks to members of the clergy of the various parishes, bringing to their attention the necessity for adequate protection against fire in churches, convents, colleges and institutions throughout the province. Three important churches of the City of Montreal, namely, Notre Dame, Maisonneuve and Viauville, are now equipped with sprinklers, vastly increasing their safety from fire.

Gas Overcomes Rochester Firemen.

Thirty-eight firemen were removed to hospitals for treatment and forty others were overcome by gas at a basement fire in The Home Store, Rochester, N. Y., on February 12, 1931. Fire department companies responding on first alarm attempted to ventilate, but due to the structure being situated on a bridge, only a limited number of openings could be made.

The building involved in the fire was of brick construction with three stories above the street level and a cellar or basement below the street level suspended on the bridge arches. The store in which the fire occurred occupies but part of the space in this building and there are no openings between it and the store on each side, either in the cellar or on the street floor. There were no openings from the cellar of this store to the sidewalk.

The ground dimensions of the store are 75 ft. long and 15 ft. wide. There are six bridge arches in the cellar, one being at each end and the others spaced about 14 feet apart. The arrangement of the arches is such that there are practically five small cellars within the large one. The cellar floor is on the level with the bottom of the bridge arches, and the street floor is laid on top of the arches. There was only one window in the cellar. This window took up almost the entire space under the rear arch. This window was boarded up and had about fifty paper boxes piled against it, presumably to keep out the cold. There were no sprinklers.

The street floor of the store contained the usual fixtures and contents to be found in a ladies' wearing apparel store. Seven paper boxes, 36 in. x 18 in. x 9 in., containing wearing apparel were stored on shelves in the cellar sec-

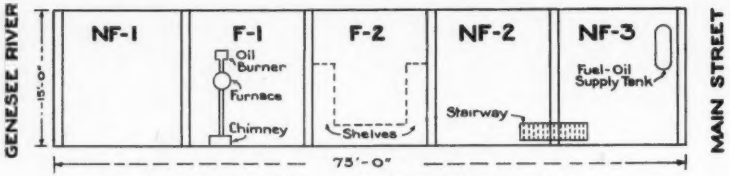


Diagram of basement of The Home Store.

tion ("A" on the diagram). There was also a box of furs, protected by camphor balls. The cellar contained nothing else except the paper boxes previously referred to, a long wooden table, the furnace, oil burner and fuel oil tank.

The first alarm for the fire was received by the fire department at 8:20 P.M. How long it had been burning previous to the alarm is not known. On the arrival of the fire department the smoke was very dense and the exact location of the fire could not immediately be ascertained. As hose streams were placed in operation the firemen entering the building were driven out partially or totally overcome by smoke or gas. At 9:07 P.M. it was deemed necessary to sound a second alarm in order to refill the depleted crews. Later calls were sent out for four additional companies—all to fight a fire which ordinarily should have been handled by the companies first to arrive.

The fire was fought for nearly seven hours. During this time a relatively small amount of material was burned. In view of the fact that the building is very old and perfectly dry, the fire did not lack combustible fuel. It seems doubtful if much water or other extinguishing agents reached the fire on account of its being on the arches. It must have gone out from other causes, the most probable of which is lack of oxygen.

As previously stated, there was practically no ventilation in the cellar. The fire started from the overheating of the furnace, which set fire to the floor above it. The floor was a double floor constructed of pine and maple with floor girders of pine. According to the City Chemist, Mr. John A. Timmerman, "the fire burned very vigorously until most of the oxygen available was consumed and then smoldered, producing the effects of a wood distillation. When the floor girders above the furnace burned through, the floor dropped on to the furnace, knocking apart the smoke pipe from the heater to the chimney. There was an accumulation of carbon monoxide (probably high) due to the incomplete combustion of all burning material, this latter condition brought about by an oxygen deficiency."

The Rochester Fire Department was equipped with gas masks. These masks were satisfactory for most gases and smoke ordinarily met with, and probably would have been effective against carbon monoxide fumes in moderate amounts. No gas mask of the cannister or filter type can be used where

there is a serious oxygen deficiency, and in such cases the self-contained oxygen mask is essential. Since this fire twelve masks of the latter type have been purchased by the fire department. This mask contains a cylinder of compressed oxygen, enabling the wearer to remain for some time in areas deficient in oxygen content.

The street floor above the furnace was about two-thirds burned away, and in the adjoining section was about half burned away. Other sections of the cellar show but little signs of fire. None of the paper boxes piled against the cellar window show any signs of fire, nor does the section containing the oil supply tank. All of the wearing apparel stored in the cellar was destroyed. None of the cellar flooring was burned. The loss to The Home Store was estimated at $20,000.

Rear view of buildings built above the Genesee River at Rochester, N. Y. The low building adjoining the nine-story structure in the foreground was the one involved in the fire.

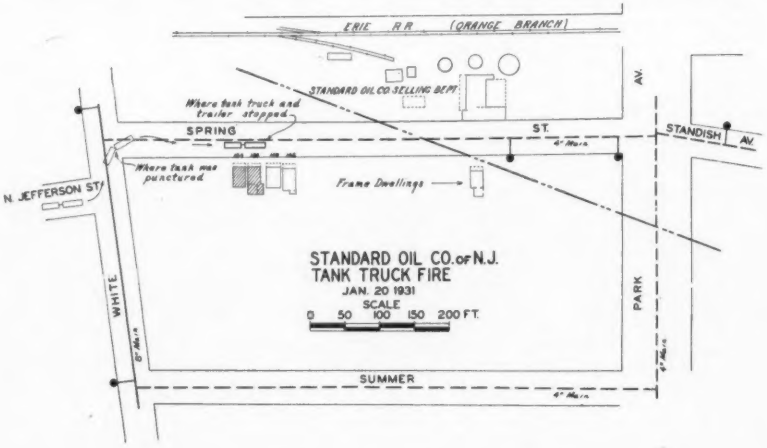
Tank Truck Fire, Orange, N. J.

By R. M. Cadman,
(Member N.F.P.A.).

A fire which demonstrates conclusively the need of every conceivable safeguard where flammable liquids are conveyed through streets in large quantities, occurred on Spring Street, Orange, N. J., about 150 feet northeast of White Street at 8:25 A.M. on January 20, 1931, when a gasoline tank truck and trailer caught fire.

The tank truck and trailer, carrying a total of 4900 gallons of gasoline, were being driven from Bayway to a distributing station in West Orange. While crossing a deep gutter at Spring and White Streets, Orange, the tongue of the trailer broke near the truck. The safety chains held the trailer, but did not prevent it from bumping the truck and puncturing the rear compartment. Gasoline poured out through the opening and ignited, either by means of a spark due to the impact, the scraping of the tongue on the pavement, or from the exhaust of the motor. The truck came to a stop in front of 134 Spring Street. A telephone call at 8:25, followed by an alarm from a street fire alarm box a minute later, brought men and apparatus of the Orange Fire Department. An additional box alarm at 8:32 brought another company from Orange, together with equipment from West Orange and East Orange.

The burning gasoline ran down the gutter for a distance of about 500 feet, but was stopped at intervals by dams made of sand secured by Chief McMillan from the Standard Oil station near by. This prevented the blazing gasoline from entering the catch basin. A westerly wind blew the flames



Left: Rear view of tank truck showing punctured tank. Right: These two houses were ignited by the burning gasoline in the street and damaged to the extent of about $6000.

from the burning tank truck toward the frame dwellings at 134 and 136 Spring Street, which caught fire, and considerable damage was done before it could be extinguished.

Four 2½-in. lines were taken from hydrants on White and Jefferson Streets. Two 2½-in. lines were taken from two pumpers, one at Spring Street and Park Avenue, and one at Standish and Park Avenues. These lines from the pumpers were connected into a deluge gun. Lack of immediately available foam equipment was the chief obstacle in handling the fire. There being no foam producing material available, it was necessary to send to Montclair for a generator and powder. As soon as these arrived, one 2½-in. line from the hydrant near the corner of White and Spring Streets was connected and the foam soon smothered the blazing gasoline.

Although no authentic figures are available, the loss on buildings will probably be about $6,000 and on the truck and contents, about $3,000. There were approximately 1500 gallons of gasoline destroyed.

Side view of tank truck, showing damage done by fire.

Fires in Which There Was Loss of Life.

Since the publication of the last QUARTERLY, the Department of Fire Record of the N.F.P.A. has received from various sources a total of 151 reports of fires in which loss of life has been a factor. For the most part the fires recorded have occurred since January 1, 1931. While the number of fires reported to the N.F.P.A. is but a small fraction of the total number that have occurred during this period, the volume of data is sufficient to indicate the predominating causes of loss of life. These reports indicate a total of 309 lives sacrificed by fire during the period, while in the same fires an almost equal number of injuries has occurred.

The fires involving the largest loss of life were those occurring on December 29, 1930, in the Queens Hotel at Cochrane, P. Q., involving a loss of eight lives; on January 28, 1931, in a log cabin dwelling at Powys, Pa., when a father and six children were burned to death and a mother and another child were severely burned; on the same date at Linton, Ind., where twenty-eight miners were killed in a powder explosion in a mine; on March 17, 1931, at Kenansville, N. C., where eleven negro convicts were trapped in a wooden stockade at a county jail; and on March 22, 1931, in a rural dwelling in Holderness, N. H., where seven children perished in flames and three others were severely burned.

Loss of Life Fires, January-March, 1931.*

Class of Fire	No. Fires	Lives Lost			
		Men	Women	Children	Total
Airplane fires	3	4	0	0	4
Automobile fires	5	4	1	4	9
Apartments, hotels, lodgings, tenements, etc.	19	20	11	9	40
Dwellings—Urban	51	19	25	25	69
Dwellings—Rural	36	12	11	58	81
Garages and filling stations	1	1	0	0	1
Industrial occupancies	8	10	0	0	10
Institutions, schools, etc.	4	16	2	0	18
Mercantile occupancies	2	2	0	0	2
Mining property	3	45	0	0	45
Other buildings	9	14	0	0	14
Other than buildings	4	2	0	2	4
Railroad property	1	1	0	0	1
Response to alarms	3	9	0	0	9
Ships	2	2	0	0	2
Total	151	161	50	98	309

*This table is made up from those reports received by the Department of Fire Record between January 1 and March 31, 1931. A few of the fires included herein occurred prior to January 1, but were not reported until subsequent to that date.

Causes of Loss of Life, January-March, 1931.

Fatalities classified according to the immediate cause of the loss of life rather than according to the cause of the fire.

Cause	Men	Women	Children	Total
Airplane fires	4	0	0	4
Automobile fires	4	1	4	9
Children and matches	0	1	8	9
Cleaning with gasoline	0	3	0	3
Clothing ignited from bonfire	0	0	1	1
Clothing ignited from cigar	1	0	0	1
Clothing ignited from hot iron	1	0	0	1
Clothing ignited from oil lamp	0	1	0	1
Clothing ignited from open grate	1	1	2	4
Clothing ignited from stove	0	6	1	7
Escaping from fire—jumped or fell	4	2	1	7
Escaping from fire—drowned	1	0	0	1
Explosion—chemical works	1	0	0	1
Explosion—gas stove	0	2	2	4
Explosion—gas and coal range	0	0	3	3
Explosion—gasoline lamp	0	0	2	2
Explosion—hospital operating room	0	1	0	1
Explosion—manufacturing plant	1	0	0	1
Explosion—mine	45	0	0	45
Explosion—powder mill	4	0	0	4
Explosion—sewer	1	0	0	1
Fell into campfire	1	0	0	1
Fell on stove	1	0	0	1
Fire fighting	8	0	0	8
Gas heater	0	0	3	3
Gasoline used to start fire	1	0	0	1
Ignition of flammable liquids or vapors	2	1	0	3
Kerosene used to start fire	6	3	9	18
Oil lamp or stove	3	3	3	9
Overcome by smoke or suffocation	6	4	3	13
Overexertion or excitement due to fire	4	1	0	4
Re-entering burning buildings	2	0	0	2
Responding to alarms	7	0	0	7
Set clothing on fire—intoxicated	1	0	0	1
Smoking in bed	1	1	0	2
Traffic accident at fire	1	0	0	1
Trapped in burning building	44	17	53	112
No data	5	2	3	10
Total	161	50	98	309

While for tabulation purposes, only those loss of life fires occurring in the United States and Canada have been used, mention should be made at this time of two disasters which, because of the number of lives lost, are of unusual interest. These disasters are the fire which occurred in the Teatro

Principal in Mexico City, and the steamship *Viking* disaster, which occurred off the cost of Newfoundland. The following information regarding these two loss of life fires has been taken from press reports.

Eleven persons were burned to death and twelve or more were severely injured in a fire which destroyed the Teatro Principal in Mexico City shortly after a midnight performance on March 2, 1931. The fire broke out, according to information, when a stage hand lowering the curtain, let is down on an electric light bulb or wire which short-circuited, igniting the drop. Then he raised the curtain in order that the dancers might receive the applause from the audience and the flames were communicated to the flies. He lowered it again and the actors were trapped on the flaming stage.

Eight of the victims sought exit from the stage from a long unused doorway which opened off from the electrician's room, but they found the door locked and were unable to open it. In the meantime the doorway through which they had entered this room caught fire and they were thus trapped. Practically all the audience was able to escape, although it is said that some panic ensued, as a result of which a number of the audience were trampled in the stampede to escape.

The other disaster, in which a large number of lives were lost, occurred aboard the steamship *Viking* off Horse Island, Newfoundland, on March 16, 1931. The *Viking* was on a sealing voyage, having aboard a number of Americans who were interested in taking motion pictures of the sealing fleet.

Members of the ship's company were gathered in the cabin when, without warning, a terrific explosion shook the ship and immediately the stern of the craft burst into flames. According to stories of survivors, the supplies of dynamite or other explosives aboard the ship were very loosely stowed and it seems likely that in some way this became ignited, either from a spark or due to careless smoking. Twenty-four persons lost their lives as a result of this disaster and a number of others were severely injured by the explosion, by being burned, or by exposure to the cold and ice.

Typical Loss of Life Fires.

Children and Matches.

L-968. LEMMON, S. D., JANUARY 6, 1931. A two and one-half year old girl was burned to death in her home when she, with two other children, was playing with matches in an upstairs room. The fire had gained considerable headway before the mother noticed it. She called the fire department and attempted to reach the children, but was unsuccessful. Two of the children escaped unaided, but one child hid under the bed. Due to the dense smoke, firemen were unable to reach the child before it was too late.

Cleaning with Gasoline.

L-959. PARKER, S. D., FEBRUARY 7, 1931. A woman died in a hospital four days after receiving burns caused by the ignition of gasoline which she

had spilled on the front of her dress. She had been washing a jacket in a basin of gasoline outdoors and had spilled some of the liquid on the front of her dress. When she went near the stove in the house her clothing ignited.

Gas Explosion.

L-958. CHICAGO, ILL., FEBRUARY 20, 1931. Three children lost their lives in an early morning fire started by a blast thought to have been caused by a leak in a combination gas and coal stove. The parents and five other children received injuries before they escaped.

Manhole Explosion.

H-30815. TORONTO, ONT., FEBRUARY 22, 1931. One man received injuries from which he died and a number of other persons had narrow escapes from death or serious injuries when an explosion occurred in a manhole on Front Street. The explosion occurred just as the victim was stepping on a manhole cover and he was thrown into the air and dropped twenty feet to the causeway beneath the Union Station. The blast ripped up the sidewalk and scattered pieces of concrete in all directions.

Smoking in Bed.

L-962. MONTREAL, P. Q., JANUARY 28, 1931. A young woman died in the hospital of injuries received when she apparently fell asleep while smoking in bed. She was found by firemen in a hallway on the third floor, where she had been overcome by smoke in attempting to escape. Severe burns about the head and body caused her death.

Starting Fires with Kerosene or Gasoline.

L-961. THURSO, ONT., JANUARY 29, 1931. A father and two little children were fatally burned when the contents of a can of kerosene, which was being poured into a cook stove, ignited. The fire quickly spread about the room and the two little children were terribly burned. The father received severe burns in attempting to save them. The children died on the way to a hospital in Ottawa. The father's death did not come until a month later.

Trapped in Burning Building.

H-30812. JAMESTOWN, R. I., MARCH 16, 1931. Five persons lost their lives in a fire which destroyed a three-story frame building at a private sanitarium for mental cases. The fire was discovered by an orderly shortly after 7:00 P.M. Difficulty in making telephone connections delayed the alarm and the entire building was in flames before the fire department arrived. Four of the victims were patients and the fifth was an orderly who was trapped while attempting to rescue his charges.

Annual Sprinkler Tables.

Statistics of Fires in Properties Having Automatic Sprinkler Protection.

NOTE.—These tabulations are made at the close of each year with the object of furnishing a basis upon which the virtues of the automatic sprinkler as an extinguishing agent can be estimated.

Section I is devoted to fires in which the behavior of sprinklers was, for the reasons given, unsatisfactory.

Section II is a statistical record of all reports of sprinkler fires in the files of the Association upon which the information obtained is sufficiently complete for statistical purposes.

In each table the results of the current year ending February 1, 1931, are given and these are compared with the results of the total thirty-five year record ending at that time.

The annual sprinkler tabulation is published this year for the thirty-fifth consecutive year. The tables show the actual fire experience with automatic sprinkler equipments in over fifty-six thousand fires. This is not intended as a complete statistical record of fires occurring in sprinklered properties; it includes only those fires reported to the Department of Fire Record in sufficient detail to give the data necessary for the tables. This is probably only a fraction of the total number of fires occurring in buildings under sprinkler protection, but with a total of 56,202 fires in the record and current reports being received at an average rate of three thousand a year, there can be no doubt that this summary as a whole is completely representative.

An exception to this statement may be made in the case of the detailed records of experience in some occupancies where only a comparatively small number of fires are reported. In order to maintain the continuity of the tables from year to year it is necessary to have every occupancy classification appear, even though there be but one sprinklered fire reported. It is obvious, however, that conclusions should not be drawn as to the effectiveness of sprinklers in an occupancy where the number of fires reported is so small that the figures may be distorted by some one unusual fire.

The several tables showing sprinkler performance are divided into columns of cases where sprinklers "extinguished fire" and cases where sprinklers "held fire in check," both of these being classed as satisfactory performance. The distinction between these two classifications is necessarily more or less arbitrary, depending upon the judgment of the original inspector. The great majority of the fires in the "held in check" columns are cases where hose streams or chemicals were used to extinguish fire in spaces which water from the sprinkler did not reach because of obstructions to distribution, concealed spaces or unsprinklered portions, but where sprinklers functioned satisfactorily in preventing the spread of fire.

In preparing these tables it is the fixed policy of the Department of Fire Record never to give the sprinklers the benefit of the doubt. In cases where there is question as to whether a given fire should be classified as "Held in Check" or "Unsatisfactory," it is always placed in the "Unsatisfactory" column. The tables thus give a very conservative picture of the efficiency of sprinklers. Likewise it should be noted that there are doubtless a large number of fires annually which are extinguished by one or two sprinkler heads where no claim for loss is made and where no report reaches the Department of Fire Record. If it were possible to include all such fires in the tables the sprinkler efficiency would approach much nearer to one hundred per cent.

The tables presented this year follow the same general plan and arrangement as in previous years. The following changes in occupancy classification have been made during the past year:

Airports and Hangars (first fire in which sprinklers operated in this classification)
Brick Works (first fire in which sprinklers operated in this classification)
Coke Mfg. (formerly in Miscellaneous)
Cocoanut Mills (formerly in Miscellaneous)
Canvas Belting (formerly in Miscellaneous)
Carborundum Works (formerly in Miscellaneous)
General Stores (this classification has been revised to include only small stores where goods of a general nature are sold)
Ice Houses (first fire in which sprinklers operated in this classification)
Rayon Mfg. (formerly Silk Mills)
Schools: Colleges and Universities
Schools: Private
Schools: Public
Schools: Trade and Industrial
} Reclassification of Schools
Stone Working (formerly in Miscellaneous)
Waterworks and Pumping Stations (formerly in Miscellaneous)

During the past year there was an increase of over 1,500 in the number of fires recorded in sprinklered properties. This is not believed to indicate a material increase in the number of fires in sprinklered property, although such protection is being extended constantly, but is thought to have been due to the increased activity of the Department of Fire Record in obtaining reports. The total number of sprinklered fire reports received during the past year was 4,565. The number of fires in which the sprinklers were not a factor was 1,294. This includes fires occurring in unsprinklered portions of buildings which did not extend to the sprinklered portions, or fires occurring in sprinklered portions which were discovered and extinguished by other means before there was sufficient heat to open sprinklers. The total number of fires since 1897 in sprinklered properties where sprinklers were not a factor is 10,558.

The present tables include four fires in properties protected by thermostatically operated open head systems. These are separately listed in Section II, Tables 1 and 2.

SECTION I.

Summary of Unsatisfactory Sprinkler Fires.

	1930-1931 No. of Fires	1930-1931 Per Cent	1897-1931 incl. No. of Fires	1897-1931 incl. Per Cent
Water shut off sprinklers	38	41.3	602	31.9
Generally defective equipment	8	8.7		
Unsprinklered portions	7	7.6	362	19.2
Defective water supply or supplies	10	10.9	171	9.1
Sprinkler system crippled due to freezing	2	2.2	50	2.6
Slow operation of dry system or defective valve	1	1.2	53	2.8
Slow or defective operation of high test heads	..	..	25	1.3
Faulty building construction, concealed spaces, vertical openings, etc.	3	3.2	93	4.9
Obstruction to distribution	3	3.2	100	5.3
Hazard of occupancy too severe for average sprinkler equipment	8	8.7	114	6.0
Explosion crippled sprinkler system	3	3.2	84	4.4
Exposure or conflagration	4	4.4	79	4.2
Plugged heads (included with Miscellaneous prior to 1921)	2	2.2	25	1.3
Miscellaneous	3	3.2	131	7.0
Total	92	100.0	1889	100.0

Fires in Which Failure Was Due to Water Shut Off Sprinklers.

	1930-1931 No. of Fires	1897-1931 No. of Fires
Water shut off for unknown reason, neglect or carelessness	11	192
Water shut off before fire was out or fire rekindled	10	102
Water shut off due to accidents or repairs	4	96
Water shut off to prevent freezing	7	139
Water shut off, probably incendiary	2	11
Water shut off, leaky dry system	2	14
Water shut off, defective gate valve	..	9
Water shut off, miscellaneous	2	39
Total	38	602

SECTION II.

Annual Revision of Sprinkler Fire Tables.

The following tables are a summary of fires occurring in properties equipped with automatic sprinklers. The total number of such fires reported during the past year was 4,565, which includes 1,294 fires where no sprinklers were opened. A number of reports were received in which the data were incomplete and these are not included in this tabulation. It may be noted that the total number of fires does not agree throughout all the tables. This is because some of the reports of fires in prior years were not sufficiently complete to include in all the tables.

Table No. 1—Number of Sprinklers Operating.

No. of Fires, 1930-1931

No. of Sprinklers Operating	Wet	%	Dry	%	No Data	Total	%
1	842	42.3	80	19.0	290	1212	37.1
2	373	18.7	63	14.9	124	560	17.1
3	220	11.0	44	10.4	79	343	10.5
4	152	7.6	28	6.7	68	248	7.6
5	75	3.8	26	6.2	45	146	4.5
6	52	2.6	20	4.7	27	99	3.0
7	31	1.6	12	2.8	13	56	1.7
8	33	1.7	6	1.4	23	62	1.9
9	32	1.6	5	1.2	15	52	1.6
10	20	1.0	9	2.1	18	47	1.4
11	11	.6	10	2.4	9	30	.9
12	11	.6	16	3.8	15	42	1.3
13	8	.4	10	2.4	3	21	.6
14	13	.7	2	.5	7	22	.7
15	10	.5	2	.5	3	15	.5
16-20	32	1.6	19	4.5	33	84	2.6
21-25	19	1.0	8	1.9	15	42	1.3
26-30	14	.7	8	1.9	5	27	.8
31-35	6	.3	9	2.1	3	18	.6
36-40	4	.2	5	1.2	4	13	.4
41-50	9	.4	7	1.7	7	23	.7
51-75	7	.3	3	.7	7	17	.5
76-100	5	.2	6	1.4	2	13	.4
Over 100	5	.2	14	3.3	13	32	.9
No Data	9	.4	6	1.4	29	44	1.3
Open head systems	..	..	4	.9	..	4	.1
Total	1993	100.0	422	100.0	857	3272	100.0

No. of Fires, 1897-1931, inclusive

No. of Sprinklers Operating	Wet	%	Dry	%	No Data	Total	%
1	13451	37.7	1493	19.7	494	15438	34.1
2	6579	18.7	1013	13.4	218	7810	17.2
3	3542	9.9	651	8.6	137	4330	9.6
4	2483	6.7	544	7.2	116	3043	6.9
5	1500	4.2	357	4.7	76	1933	4.3
6	1205	3.4	338	4.5	61	1604	3 5
7	831	2.3	253	3.4	33	1117	2.5
8	788	2.2	213	2.8	46	1047	2.3
9	523	1.4	173	2.3	28	724	1.6
10	473	1.3	151	2.0	40	664	1.5
11	337	.9	130	1.7	15	482	1.1
12	371	1.1	163	2.2	33	567	1.3
13	219	.6	120	1.6	12	351	.8
14	263	.7	109	1.4	15	387	.9
15	217	.6	105	1.4	11	333	.7
16-20	740	2.1	330	4.4	56	1126	2.5
21-25	439	1.2	239	3.2	24	702	1.5
26-30	307	.9	169	2.2	18	494	1.1
31-35	183	.5	112	1.5	10	305	.7
36-40	166	.5	100	1.3	11	277	.6
41-50	205	.6	129	1.7	13	347	.6
51-75	287	.8	177	2.3	12	476	1.1
76-100	129	.4	100	1.3	7	236	.5
Over 100	405	1.1	315	4.1	26	746	1.6
No Data	89	.2	73	1.0	502	664	1.5
Open head systems	..	..	4	.1	..	4	..
Total	35732	100.0	7561	100.0	2014	45307	100.0
Water shut off sprinklers						337	
Total						45,644	

Table No. 2—Number of Sprinklers Operating.

No. of Fires, 1897-1931, inclusive

No. of Sprinklers Operating	Wet	%	Dry	%	No Data	Total	%
1	13451	37.7	1493	19.7	494	15438	34.1
2 or less	20030	56.3	2506	33.1	712	23248	51.3
3 or less	23572	66.2	3157	42.0	849	27578	60.7
4 or less	26055	73.2	3701	48.9	965	30621	67.7
5 or less	27555	77.2	4058	53.7	1041	32654	72.1
6 or less	28760	80.6	4396	58.2	1102	34258	75.7
7 or less	29591	82.8	4649	61.5	1135	35375	78.0
8 or less	30379	85.3	4862	64.3	1181	36422	80.4
9 or less	30902	86.5	5035	66.5	1209	37146	82.0
10 or less	31375	87.9	5186	68.4	1249	37810	83.5
11 or less	31712	88.9	5316	70.1	1264	38294	84.6
12 or less	32083	90.0	5479	72.5	1299	38863	85.8
13 or less	32302	90.5	5599	74.0	1311	39212	86.5
14 or less	32565	91.1	5708	75.4	1323	39597	87.4
15 or less	32782	91.9	5813	76.8	1335	39930	88.2
20 or less	33522	93.9	6143	81.2	1391	41056	90.7
25 or less	33961	95.4	6382	84.3	1415	41758	92.2
30 or less	34268	96.0	6551	86.7	1433	42252	93.2
35 or less	34451	96.6	6663	88.0	1443	42557	93.9
40 or less	34617	96.8	6763	89.4	1454	42834	94.6
50 or less	34822	97.5	6892	91.2	1467	43181	95.4
75 or less	35109	98.4	7069	93.4	1479	43657	96.4
100 or less	35238	98.7	7169	94.9	1486	43893	96.9
Over 100	405		315		26	746	
No Data	89		73		502	664	
Open head systems	..		4		..	4	
Total	35732		7561		2014	45307	
Water shut off sprinklers						337	
Total						45644	

Table No. 3—Effect of Sprinklers.

	1930-1931 No. of Fires	%	1897-1931, incl. No. of Fires	%
Practically or entirely extinguished	2548	77.9	31033	68.0
Held fire in check	632	19.3	12680	27.9
Total Satisfactory	3180	97.2	43713	95.9
Unsatisfactory	92	2.8	1889	4.1
Total	3272		45602	

Table No. 4—Effect of Sprinklers by Class of Occupancy.

	Extinguished Fire		Held Fire in Check		Total Satisfactory		Unsatisfactory		Total No. of Fires
	No.	%	No.	%	No.	%	No.	%	
Abrasive Works	16	69.6	5	21.7	21	91.3	2	8.7	23
Agricultural Implements	69	58.0	44	37.0	113	95.0	6	5.0	119
Airplane Factories	5	50.0	5	50.0	10	100.0	..	..	10
Airports and Hangars	..	..	2	100.0	2	100.0	..	..	2
Alcohol Distilleries	..	..	1	100.0	1	100.0	..	..	1
Aluminum Works	3	42.9	3	42.9	6	85.8	1	14.2	7
Amusement Resorts	3	50.0	1	16.7	4	66.7	2	33.3	6
Apartment Houses	94	84.0	18	16.0	112	100.0	..	..	112
Artificial Flower Mfg	16	100.0	..	..	16	100.0	..	..	16
Artificial Leather Mfg	19	40.6	26	54.1	45	94.7	3	5.3	48
Asbestos Works	18	54.6	12	36.4	30	91.0	3	9.0	33
Automobile and Bicycle Mfg	279	63.6	141	33.4	420	97.0	19	3.0	439
Automobile Paint Shops	9	90.0	1	10.0	10	100.0	..	..	10
Awning Factories	7	70.0	3	30.0	10	100.0	..	..	10
Auto and Carriage Body Mfg	145	58.5	81	32.7	226	91.2	22	8.8	248
Bag Factories	42	63.8	21	31.7	63	95.5	3	4.5	66
Bakeries	155	75.3	43	21.0	198	96.3	8	3.7	206
Basket Factories	11	84.7	2	15.3	13	100.0	..	..	13
Battery Mfg	34	70.9	13	27.1	47	98.0	1	2.0	48
Bolt, Nut and Screw Works	23	60.6	13	34.2	36	94.8	2	5.2	38
Bottle Caps and Seals Mfg	29	54.6	24	45.4	53	100.0	..	..	53
Bottling Works	6	66.7	2	22.1	8	88.8	1	11.2	9
Bowling Alleys, Pool Rooms, etc	13	93.0	1	7.0	14	100.0	..	..	14
Braid Mills	49	74.4	15	22.6	64	97.0	2	3.0	66
Brass Works	79	72.4	27	25.0	106	97.4	3	2.6	109
Breweries	5	83.4	1	16.6	6	100.0	..	..	6
Brick and Tile Works	1	100.0	..	..	1	100.0	..	..	1
Broom Factories	17	63.0	8	29.6	25	92.6	2	7.4	27
Brush Factories	29	69.0	13	31.0	42	100.0	..	..	42
Buildings Under Construction	3	50.0	3	50.0	6	100.0	..	..	6
Button Factories	73	84.0	12	12.7	85	96.7	2	3.3	87
Candle Factories	8	53.3	7	46.7	15	100.0	..	..	15
Candy Factories	206	73.0	67	23.5	273	96.5	10	3.5	283
Canning Factories	18	64.3	7	25.0	25	89.3	3	10.7	28
Canvas Belting	4	66.7	2	33.3	6	100.0	0	..	6
Carbon Works	8	89.0	1	11.0	9	100.0	..	..	9
Carborundum Mfg	5	71.5	2	28.5	7	100.0	..	..	7
Car Houses	37	44.0	39	46.5	76	90.5	8	9.5	84
Car Works	88	61.5	50	35.0	138	96.5	5	3.5	143
Carpet and Rug Mills	191	64.1	97	32.5	288	96.6	10	3.4	298
Cement and Plaster Mills	11	64.8	3	17.6	14	82.4	3	17.6	17
Cereal Mills	38	63.4	14	23.2	52	86.6	8	13.4	60
Chemical and White Lead Works	161	60.6	86	32.3	247	92.9	19	7.1	266
Clock and Watch Mfg	13	81.3	3	18.7	16	100.0	..	..	16
Clothing Mfg	2024	85.7	317	13.4	2341	99.1	19	.9	2360
City Clubs	16	76.1	4	19.0	20	95.1	1	4.9	21
Country Clubs	6	60.0	4	40.0	10	100.0	..	..	10
Coal and Wood Storage	2	66.7	4	33.3	6	100.0	..	..	6
Cocoanut Mills	5	71.4	2	28.6	7	100.0	..	..	7
Coffee and Spice Mills	81	70.4	30	26.1	111	96.5	4	3.5	115
Coffin and Casket Mfg	71	73.2	21	21.6	92	94.8	5	5.2	97
Coke Mfg	..	..	1	50.0	1	50.0	1	50.0	2
Cold Storage Plants	12	66.7	6	33.3	18	100.0	..	..	18
Cooperage Plants	59	60.2	27	27.6	86	87.8	12	12.2	98
Cordage Works	245	65.4	117	31.2	362	96.6	13	3.4	375
Cork Factories	36	50.0	31	43.1	67	93.1	5	6.9	72
Cotton Gins	10	62.5	5	31.2	15	93.7	1	6.3	16
Cotton Mills	5361	63.7	2956	35.1	8317	98.8	106	1.2	8423

	Extinguished Fire		Held Fire in Check		Total Satisfactory		Unsatisfactory		Total No. of Fires
	No.	%	No.	%	No.	%	No.	%	
Cotton Seed Oil Mills	42	48.3	30	34.5	72	82.8	15	17.2	87
Cotton Warehouses	173	46.4	170	45.6	343	92.0	30	8.0	373
Cutlery and Tool Mfg	32	61.5	17	32.7	49	94.2	3	5.8	52
Dairies and Creameries	6	100.0	..	..	6	100.0	..	..	6
Department Stores	615	78.6	145	18.5	760	97.1	23	2.9	783
Distilleries	10	62.5	5	31.2	15	93.7	1	6.3	16
Doll Factories	61	59.8	41	40.2	102	100.0	..	..	102
Drug Mfg. & Warehouses	232	80.6	51	17.7	283	98.3	5	1.7	288
Dry Cleaning Establishments	12	52.2	11	47.8	23	100.0	..	..	23
Dry Goods Stores	335	85.3	53	13.5	388	98.8	5	1.2	393
Dwellings	..	..	..	..	..	..	1	100.0	1
Dyeing, Bleaching, Finishing	231	55.6	169	40.6	400	96.2	16	3.8	416
Electrical Appliance Mfg	423	69.8	171	28.2	594	98.0	12	2.0	606
Electric Light and Power	6	37.5	7	43.7	13	81.2	3	18.8	16
Elevators, Grain	33	37.5	31	35.2	64	72.7	24	27.3	88
Excelsior Factories	32	68.1	11	23.4	43	91.5	4	8.5	47
Fertilizer Plants	30	63.8	13	27.7	43	91.5	4	8.5	47
Fireworks Plants	..	..	2	100.0	2	100.0	..	..	2
Flax and Linen Mills	44	55.0	36	45.0	80	100.0	..	..	80
Flour and Grist Mills	82	54.6	42	28.0	124	82.6	26	17.4	150
Forge and Smithy	22	66.7	9	27.1	31	93.8	2	6.2	33
Foundries	215	59.9	127	35.4	342	95.3	17	4.7	359
Fruits, Dried, Mfg	1	100.0	..	..	1	100.0	..	..	1
Fur Mfg	158	93.0	9	5.3	167	98.3	3	1.7	170
Furniture Factories	873	66.6	340	26.0	1213	92.6	97	7.4	1310
Furniture Stores	106	77.4	23	16.8	129	94.2	8	5.8	137
Garages	427	69.0	182	29.4	609	98.4	10	1.6	619
Garbage Reduction Plants	3	60.0	1	20.0	4	80.0	1	20.0	5
Gas Works	2	40.0	2	40.0	4	80.0	1	20.0	5
General Stores	..	..	1	100.0	1	100.0	..	..	1
Glass Factories	87	57.2	48	31.6	135	88.7	17	11.2	152
Glove Factories	17	68.0	7	28.0	24	96.0	1	4.0	25
Glue Factories	10	45.5	9	40.9	19	86.4	3	13.6	22
Groceries	167	76.6	41	18.8	208	95.4	10	4.6	218
Gum Mfg	7	87.5	1	12.5	8	100.0	..	..	8
Hair Works	25	78.2	7	21.8	32	100.0	..	..	32
Hardware Stores	115	82.8	22	15.8	137	98.6	2	1.4	139
Harness and Fancy Leather	181	83.8	33	15.3	214	99.1	2	.9	216
Hat Factories	331	78.6	77	18.3	408	96.9	13	3.1	421
Hatters' Fur Works	21	56.8	10	27.0	31	83.8	6	16.2	37
Hotel	76	81.8	15	16.1	91	97.9	2	2.1	93
Resort Hotel	8	61.5	5	38.5	13	100.0	..	..	13
Ice Cream Mfg	4	44.4	5	55.6	9	100.0	..	..	9
Ice Houses	..	..	1	100.0	1	100.0	..	..	1
Ice Manufacturing	2	66.7	1	33.3	3	100.0	..	..	3
Idle Property	3	13.6	3	13.6	6	27.2	16	72.8	22
Incandescent Lamp Works	25	65.8	13	34.2	38	100.0	..	..	38
Institutions	25	67.6	10	27.0	35	94.6	2	5.4	37
Insulated Wire Works	49	65.4	25	33.3	74	98.7	1	1.3	75
Jewelry Factories	188	85.1	27	12.2	215	97.3	6	2.7	221
Junk Shops	24	70.7	8	23.4	32	94.1	2	5.9	34
Knitting Mills, Cop Yarn	68	67.3	26	25.8	94	93.1	7	6.9	101
Knitting Mills, Full Process	580	66.8	261	30.0	841	96.8	28	3.2	869
Lamp Shade Factories	37	92.5	3	7.5	40	100.0	..	..	40
Laundries	122	73.5	40	24.1	162	97.6	4	2.4	166
Lead Pencil Factories	18	69.3	7	26.9	25	96.2	1	3.8	26
Linoleum Works	30	27.5	63	57.8	93	85.3	16	14.7	109
Linseed Oil Works	22	50.0	14	31.8	36	81.8	8	18.2	44
Lumber Yards	4	100.0	..	..	4	100.0	..	..	4

	Extinguished Fire		Held Fire in Check		Total Satisfactory		Unsatisfactory		Total No. of Fires
	No.	%	No.	%	No.	%	No.	%	
Macaroni Factories	9	69.2	2	15.4	11	84.6	2	15.4	13
Machine Shops and Works	405	70.7	143	25.0	548	95.7	26	4.3	574
Mail Order Houses	52	91.2	5	8.8	57	100.0	..	..	57
Match Factories	64	75.4	16	18.8	80	94.2	5	5.8	85
Mattress Factories	548	69.1	230	29.0	778	98.1	15	1.9	793
Mercantile (Miscellaneous)	979	82.0	185	15.5	1164	97.5	30	2.5	1194
Metal Reduction Plants	11	68.8	5	31.2	16	100.0	..	..	16
Metal Workers†	1141	63.8	572	32.0	1713	95.8	75	4.2	1788
Mining Property	2	50.0	1	25.0	3	75.0	1	25.0	4
Mirorr Mfg.	17	89.5	2	10.5	19	100.0	..	..	19
Miscellaneous	431	75.0	119	20.8	550	95.8	24	4.2	574
Morocco Leather	59	51.3	44	38.3	103	89.6	12	10.4	115
Motion Picture Exchanges	46	83.7	7	12.7	53	96.3	2	3.7	55
Motion Picture Studio	22	71.0	9	29.0	31	100.0	..	..	31
Motion Picture Theatres	63	80.8	9	11.5	72	92.3	6	7.7	78
Multiple Occupancy	28	58.4	15	31.2	43	89.6	5	10.4	48
Munition Plants	25	43.9	23	40.4	48	84.3	9	15.7	57
Musical Instruments Factory	153	69.6	60	27.2	213	96.8	7	3.2	220
Office Buildings	75	87.2	11	12.8	86	100.0	..	..	86
Oil Cloth Works	29	49.2	23	39.0	52	88.2	7	11.8	59
Oil Clothing Factories	14	70.0	5	25.0	19	95.0	1	5.0	20
Oil Refineries—Animal	3	50.0	3	50.0	6	100.0	..	..	6
Oil Refineries—Mineral	6	60.0	4	40.0	10	100.0	..	..	10
Oil Refineries—Vegetable	13	48.1	10	37.1	23	85.2	4	14.8	27
Optical Works	17	58.6	12	41.4	29	100.0	..	..	29
Packing Houses	183	69.9	68	25.9	251	95.8	11	4.2	262
Paint and Varnish Works	276	66.2	126	30.3	402	96.5	15	3.5	417
Paper Box and Paper Products	313	75.5	93	22.2	406	97.7	9	2.3	415
Paper Coating Mills	23	69.8	6	18.1	29	87.9	4	13.1	33
Paper Mills	581	51.6	446	39.6	1027	91.2	99	8.8	1126
Patent Leather (see also Tanneries)	14	38.9	17	47.2	31	86.1	5	13.9	36
Peanut Roasting Plants	2	66.7	1	33.3	3	100.0	..	..	3
Phonograph Works	33	71.7	12	26.1	45	97.8	1	2.2	46
Photographic Establishments	57	76.0	17	22.6	74	98.6	1	1.4	75
Picture Frame Mfg	55	65.5	23	27.4	78	92.9	6	7.1	84
Piers and Wharves	15	48.4	14	45.2	29	93.6	2	6.4	31
Plumbers' Supplies	36	70.7	12	23.5	48	94.2	3	5.8	51
Potteries	56	62.2	25	28.1	81	91.0	8	9.0	89
Printing and Lithographing	1017	81.9	202	16.3	1219	98.2	22	1.8	1241
Public Buildings	3	75.0	1	25.0	4	100.0	..	..	4
Pulp Mills	39	35.4	46	41.9	85	77.3	25	22.7	110
Pyroxylin Plastic Mfg Fabricating	219	66.8	78	23.8	297	90.6	31	9.4	328
Radios and Accessories	44	83.0	7	13.2	51	96.2	2	3.8	53
Railroad Property	3	25.0	8	66.7	11	91.7	1	8.3	12
Rayon Mills	24	85.7	3	10.7	27	96.4	1	3.6	28
Restaurants	115	73.3	39	24.8	154	98.1	3	1.9	157
Rice Mills	2	33.3	1	16.7	3	50.0	3	50.0	6
Rolling, Wire and Tube Mills	66	64.1	34	33.0	100	97.1	3	2.9	103
Roofing Works	41	41.0	50	50.0	91	91.0	9	9.0	100
Rooming and Lodging Houses	8	89.0	..	..	8	89.0	1	11.0	9
Rubber Cloth Factories	46	56.8	31	38.3	77	95.1	4	4.9	81
Rubber Reclaiming Works	14	38.9	15	41.7	29	80.6	7	19.4	36
Rubber Mills	233	52.4	188	42.2	421	94.6	24	5.4	445
Salt Works	2	50.0	2	50.0	4	100.0	..	..	4
Saw and Planing Mills	105	41.8	85	33.9	190	75.7	61	24.3	251
Schools—Colleges and Universities	12	80.0	3	20.0	15	100.0	..	..	15
Schools—Private	3	75.0	1	25.0	4	100.0	..	..	4
Schools—Public	6	85.8	1	14.2	7	100.0	..	..	7
Schools—Trade and Industrial	11	84.6	1	7.7	12	92.3	1	7.7	13

	Extinguished Fire		Held Fire in Check		Total Satisfactory		Unsatisfactory		Total No. of Fires
	No.	%	No.	%	No.	%	No.	%	
Shipyards	12	54.6	9	40.8	21	95.4	1	4.6	22
Shoddy Mills	251	66.2	106	28.0	357	94.2	22	5.8	379
Shoe Factories	843	74.0	255	22.4	1098	96.4	41	3.6	1139
Shoe Mfg. Accessories	88	68.2	36	27.9	124	96.1	5	3.9	129
Shoe Stores	72	90.0	8	10.0	80	100.0	..	..	80
Silk Mills	160	79.3	34	16.8	194	96.1	8	3.9	202
Skin Mfg. (see also Tanneries)	15	71.5	5	23.8	20	95.3	1	4.7	21
Smelting and Refining	2	40.0	3	60.0	5	100.0	..	..	5
Soap Manufacturing	48	71.7	16	23.9	64	95.6	3	4.4	67
Stables	19	76.0	6	24.0	25	100.0	..	..	25
Stamping and Sheet Metal Works.	147	59.3	85	34.3	232	93.6	16	6.4	248
Starch and Glucose Works	15	55.6	4	14.8	19	70.4	8	29.6	27
Sugar Refineries	36	53.0	29	42.7	65	95.7	3	4.3	68
Tanneries	67	53.6	49	39.2	116	92.8	9	7.2	125
Tenant Manufacturing	1260	76.7	311	18.9	1571	95.6	73	4.4	1644
Theatres	80	74.0	21	19.5	101	93.5	7	6.5	108
Tobacco Factories	81	73.0	27	24.4	108	97.4	3	2.6	111
Trunk Factories	40	75.5	8	15.1	48	90.6	5	9.4	53
Umbrella Mfg.	18	78.4	4	17.3	22	95.7	1	4.3	23
Vacant Buildings	20	69.0	6	20.7	26	89.7	3	10.3	29
Wall Paper Factories	25	71.5	6	17.1	31	88.6	4	11.4	35
Warehouses	581	71.8	186	22.9	767	94.7	43	5.3	810
Waste and Batting Mills	344	60.8	199	35.2	543	96.0	23	4.0	566
Waste Paper and Rag Shops	151	63.4	76	32.0	227	95.4	11	4.6	238
Water Works—Pumping Stations	..	..	1	100.0	1	100.0	..	..	1
Weaving Mills	169	67.9	73	29.3	242	97.2	7	2.8	249
Window Shade Factories	14	73.8	3	15.7	17	89.5	2	10.5	19
Woodworkers, Class A*	196	55.3	111	31.4	307	86.7	47	13.3	354
Woodworkers, Class B*	187	52.3	138	38.5	325	90.8	33	9.2	358
Woodworkers, Class C*	175	61.2	96	33.5	271	94.7	15	5.3	286
Woodworkers, Class D*	122	57.0	69	32.2	191	89.2	23	10.8	214
Woodworkers, Class E*	238	66.6	105	29.4	343	96.0	14	4.0	357
Woodworkers, Class F*	44	61.1	24	33.4	68	94.5	4	5.5	72
Woolen Mills	1099	70.2	400	25.5	1499	95.7	70	4.3	1569
Wool Scouring Plants	31	64.6	14	29.2	45	93.8	3	6.2	48
Wool Storehouses	29	65.9	12	27.3	41	93.2	3	6.8	44
Worsted Mills	86	58.9	46	31.5	132	90.4	14	9.6	146
Total Sprinkler Fires	31,033		12,680		43,713		1,889		45,602

*The Woodworkers are classified as follows:

Class A. Interior Woodwork, builders' supplies (including veneer works).

Class B. Box Factories (including cigar boxes).

Class C. Miscellaneous Woodworkers. Steam power tenant Woodworkers. Woodworkers where there is a lack of detailed information as to class.

Class D. Sash, Door and Blind Factories.

Class E. Hard Wood Turning (wheels, pipes, novelties, bobbins, spools, etc., last and wood heel factories).

Class F. Pails and Woodenware (plates, wooden bowls, tubs, etc.).

†Other Metal Working Occupancies are included under Agricultural Implements; Automobile and Bicycle Factories; Bolt, Nut and Screw Works; Electrical Appliances; Forge and Smithy; Foundries; Machine Works; Rolling, Wire and Tube Works; and Stamping and Sheet Metal Works.

Table 5—Classification of Unsatisfactory Sprinkler Fires by Occupancy.

	Water shut off sprinklers.	Generally defective equipment and unsprinklered portions.	Defective water supply or supplies.	Sprinkler system crippled due to freezing.	Slow operation of dry system or defective dry valve.	Slow or defective operation of high test heads.	Faulty building construction, concealed spaces, vertical openings.	Obstruction to distribution.	Hazard of occupancy too severe for average sprinkler equipment.	Sprinkler system crippled by explosion.	Exposure or conflagration.	Plugged heads.	Miscellaneous.	Total.
Abrasive Works	..	1	..	..	..	..	..	..	..	..	..	..	1	2
Agricultural Implem'ts Mfg.	4	1	..	..	..	..	..	1	..	..	..	..	..	6
Aluminum Works	..	..	..	..	..	..	..	..	..	1	..	..	..	1
Amusement Resorts	2	..	..	..	..	..	..	..	..	..	..	..	..	2
Artificial Leather	..	..	..	..	..	..	1	..	..	2	..	..	..	3
Asbestos Plants	..	..	2	..	..	..	..	..	..	1	..	..	..	3
Auto and Bicycle Factories	7	3	1	..	1	..	..	4	..	2	1	..	..	19
Auto and Carriage Bodies	4	5	3	..	2	..	1	2	1	1	2	1	..	22
Bag Factories	..	..	..	..	..	1	..	1	..	..	..	1	..	3
Bakeries	4	1	..	..	..	..	1	..	..	..	..	..	2	8
Battery Mfg. Plants	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Bolt, Nut and Screw Works	1	1	..	..	..	..	..	..	..	..	..	..	..	2
Bottling Works	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Braid Mills	..	1	..	..	..	..	..	1	..	..	..	..	..	2
Brass Works	1	1	..	..	..	..	..	..	..	..	..	..	1	3
Broom Factories	2	..	..	..	..	..	..	..	..	..	..	..	..	2
Button Factories	..	..	..	2	..	..	..	..	..	..	..	..	..	2
Candy Factories	3	..	..	1	1	..	2	..	1	..	1	..	1	10
Canneries	1	..	..	..	1	..	..	..	..	..	1	..	..	3
Car Houses	2	3	1	..	1	..	..	1	..	..	..	..	..	8
Car Works	2	1	..	..	..	..	1	1	..	..	..	..	..	5
Carpet and Rug Mills	4	2	3	..	..	..	..	1	..	..	..	..	..	10
Cement and Plaster Works	1	1	..	..	1	..	..	..	..	..	..	..	..	3
Cereal Mills	..	2	1	..	..	..	..	1	..	4	..	..	..	8
Chemical & White Lead Wks.	3	5	..	..	..	..	..	..	5	5	..	..	1	19
Clothing Factories	5	2	2	1	..	..	4	2	..	..	1	1	..	18
City Clubs	..	..	..	..	..	..	1	..	..	..	..	..	..	1
Coffee and Spice Mills	2	..	..	..	..	..	..	1	..	1	..	..	..	4
Coffin and Casket Factories	2	..	..	1	1	..	1	..	..	..	..	..	..	5
Coke Mfg.	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Cooperage Plants	1	4	..	..	..	1	..	4	..	..	2	..	..	12
Cordage Works	4	4	1	1	..	..	..	2	..	..	..	..	1	13
Cork Factories	1	..	1	..	..	..	..	..	1	1	..	..	1	5
Cotton Gins	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Cotton Mills	36	25	11	2	2	1	5	2	3	1	..	3	15	106
Cotton Seed Oil Mills	3	5	3	..	..	..	..	..	1	..	..	..	3	15
Cotton Warehouses	14	2	2	..	..	..	1	4	3	..	..	..	4	30
Cutlery and Tool Mfg.	1	1	1	..	..	..	..	..	..	..	..	..	..	3
Department Stores	9	7	..	..	1	..	1	2	..	..	2	..	1	23
Distilleries	..	..	..	..	..	..	..	..	..	..	1	..	..	1
Drug Mfg. and Warehouses	..	..	..	..	1	..	..	..	..	..	3	..	1	5
Dry Goods Store	4	..	..	..	..	..	..	1	..	..	..	..	..	5
Dwellings	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Dyeing, Bleach'g & Finish'g	6	3	1	..	1	1	..	1	..	..	1	1	1	16
Electrical Appliances	3	..	2	..	..	..	1	1	..	1	..	1	3	12
Elec. Light & Power Plants	1	1	..	..	..	..	..	1	..	..	..	..	..	3
Elevators, Grain	1	5	5	..	4	..	2	1	..	3	2	..	1	24

	Water shut off sprinklers.	Generally defective equipment and unsprinklered portions.	Defective water supply or supplies.	Sprinkler system crippled due to freezing.	Slow operation of dry system or defective dry valve.	Slow or defective operation of high test heads.	Faulty building construction, concealed spaces, vertical openings.	Obstruction to distribution.	Hazard of occupancy too severe for average sprinkler equipment.	Sprinkler system crippled by explosion.	Exposure or conflagration.	Plugged heads.	Miscellaneous.	Total.
Excelsior Factories	..	..	2	..	1	..	..	..	1	..	..	..	..	4
Fertilizer Plants	2	1	..	..	1	..	..	..	..	..	..	..	..	4
Flour and Grist Mills	8	3	2	..	1	..	1	1	2	4	2	..	2	26
Forge and Smithy	..	..	..	..	..	..	..	1	..	..	..	1	..	2
Foundries	12	1	1	..	..	..	1	..	..	2	..	..	..	17
Fur Mfg	1	..	..	..	..	..	1	..	..	..	..	..	1	3
Furniture Factories	30	20	8	4	1	..	4	10	11	1	4	2	2	97
Furniture Stores	5	..	..	..	1	..	1	..	..	..	..	..	..	7
Garages	5	..	..	1	1	..	..	2	..	..	..	..	1	10
Garbage Reduction Plants	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Gas Works	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Glass Factories	4	3	2	1	..	..	3	1	..	..	..	..	3	17
Glove Factories	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Glue Factories	2	..	..	..	..	..	..	..	1	..	..	..	..	3
Groceries	5	..	1	..	1	..	1	..	1	1	..	..	..	10
Hardware Stores	1	..	..	..	..	..	..	..	..	..	..	..	1	2
Harness and Fancy Leather	..	..	1	..	..	..	..	..	..	..	..	..	1	2
Hat Factories	4	4	1	..	1	..	..	1	..	..	..	..	2	13
Hatters' Fur Works	4	..	1	..	..	..	..	..	..	..	..	..	..	5
Hotels	..	1	1	..	..	..	1	..	..	..	..	..	..	3
Idle Property	13	..	..	1	..	..	..	1	1	..	..	..	..	16
Institutions	..	..	..	..	1	..	..	..	1	..	..	..	..	2
Insulated Wire Works	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Jewelry Factories	2	1	..	2	..	..	1	..	..	..	..	..	..	6
Junk Shops	1	..	..	..	..	..	..	..	..	..	1	..	..	2
Knitting Mills, Cop Yarn	1	1	3	..	..	..	..	1	..	1	..	..	..	7
Knitting Mills, Full Process	9	10	5	1	1	..	1	..	..	1	..	..	..	28
Laundries	2	..	1	..	..	..	..	1	..	..	..	..	..	4
Lead Pencil Factories	..	..	..	..	..	..	..	..	..	1	..	..	..	1
Linoleum Works	..	6	..	..	..	..	1	2	7	..	..	..	..	16
Linseed Oil Works	1	1	..	..	..	..	1	..	1	2	..	2	..	8
Macaroni Factories	2	..	..	..	..	..	..	..	..	..	..	..	..	2
Machine Shops and Works	15	6	1	1	..	1	..	..	..	2	..	..	..	26
Match Factories	2	..	..	..	..	..	..	..	2	..	..	..	1	5
Mattress Factories	10	2	..	1	..	..	..	2	..	..	..	..	..	15
Mercantile Miscellaneous	11	6	1	2	..	..	3	..	..	1	4	..	2	30
Metal Workers†	23	19	4	1	..	2	5	2	6	5	2	2	4	75
Mining Property	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Miscellaneous	3	4	2	..	1	1	3	..	5	..	2	..	3	24
Morocco Leather (see also Tanneries)	5	3	..	..	2	..	1	..	..	..	..	..	1	12
Motion Picture Exchanges	..	..	..	..	..	..	..	..	2	..	..	..	..	2
Motion Picture Theatres	2	1	..	..	..	..	..	1	..	1	1	1	..	7
Multiple Occupancy	..	1	..	1	..	..	2	..	..	..	..	..	..	4
Munitions Plants	2	..	..	1	..	..	..	..	4	1	..	..	1	9
Musical Instrum't Factories	1	4	..	..	..	..	1	..	..	..	1	..	..	7
Oil Cloth Works	..	..	..	..	..	..	..	1	6	..	..	..	..	7
Oil Clothing Factories	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Oil Refineries—Vegetable	2	..	2	..	..	..	..	..	..	..	..	..	..	4

	Water shut off sprinklers.	Generally defective equipment and unsprinklered portions.	Defective water supply or supplies.	Sprinkler system crippled due to freezing.	Slow operation of dry system or defective dry valve.	Slow or defective operation of high test heads.	Faulty building construction, concealed spaces, vertical openings.	Obstruction to distribution.	Hazard of occupancy too severe for average sprinkler equipment.	Sprinkler system crippled by explosion.	Exposure or conflagration.	Plugged heads.	Miscellaneous.	Total.
Packing Houses	3	2	1	..	2	..	..	..	1	1	..	..	1	11
Paint and Varnish Works	2	3	5	..	..	..	3	..	1	1	..	..	..	15
Paper Box & Paper Products	5	1	..	..	1	..	..	2	..	..	..	1	..	10
Paper Coating Mills	1	..	..	..	..	..	..	2	..	..	..	..	..	3
Paper Mills	27	23	14	3	1	3	2	3	4	3	2	1	13	99
Patent Leather (see also Tanneries)	1	..	1	1	..	..	1	..	..	..	1	..	..	5
Phonograph Works	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Photograph Establishments	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Picture Frame Mfg	1	2	1	1	..	..	..	1	..	..	..	..	..	6
Piers and Wharves	..	1	1	..	..	..	..	..	..	..	..	..	..	2
Plumbers' Supplies	2	1	..	..	..	..	..	..	..	..	..	..	..	3
Potteries	3	2	1	1	..	..	..	..	..	1	..	..	..	8
Printing and Lithographing	9	4	1	..	..	..	2	1	1	..	3	..	1	22
Pulp Mills	10	4	4	..	1	1	1	..	1	1	..	..	2	25
Pyroxylin Plastic Mfg. and Fabricating	3	1	3	1	1	..	2	2	11	5	2	..	..	31
Radio and Accessories	1	..	..	..	..	..	..	..	..	..	..	1	..	2
Railroad Property	..	..	..	..	..	..	..	..	..	..	..	1	..	1
Rayon	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Restaurants	1	1	..	..	..	..	1	..	..	..	..	..	..	3
Rice Mills	..	1	1	..	..	..	..	..	..	..	..	..	1	3
Rolling, Wire & Tube Mills	..	..	..	..	1	1	1	..	..	..	..	..	..	3
Roofing Works	3	2	..	1	..	..	1	1	..	1	..	..	..	9
Rooming Houses	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Rubber Cloth Works	2	1	..	..	..	..	..	..	..	..	..	..	1	4
Rubber Mills	9	..	..	1	..	..	..	1	7	4	..	1	1	24
Rubber Reclaiming Works	2	..	..	..	..	..	1	1	1	1	1	..	..	7
Saw and Planing Mills	14	13	5	..	5	1	6	2	5	..	5	1	4	61
Schools—Private	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Schools—Trade & Industrial	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Shipyards	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Shoddy Mills	6	3	6	..	1	3	1	1	..	..	..	..	1	22
Shoe Factories	18	7	3	..	..	1	..	2	..	2	5	..	3	41
Shoe Mfg. Accessories	2	2	..	..	..	..	..	..	..	..	..	..	1	5
Silk Mills	3	2	..	..	..	..	..	..	..	1	..	..	1	7
Skin Mills	..	..	..	..	1	..	..	..	..	..	..	..	..	1
Soap Manufacturing	2	1	..	..	..	..	..	..	..	..	..	..	..	3
Stamping & Sht. Metal Wks.	3	4	1	..	1	..	2	1	..	1	2	..	1	16
Starch and Glucose Works	..	..	..	..	..	..	..	..	1	7	..	..	..	8
Sugar Refineries	1	1	..	..	..	..	..	..	..	1	..	..	..	3
Tanneries	1	2	..	3	..	..	..	..	1	..	1	..	1	9
Tenant Manufacturing	41	8	2	3	1	..	3	1	2	..	7	2	3	73
Theatres	4	3	..	..	..	..	..	..	..	..	..	..	..	7
Tobacco Factories	1	1	..	..	..	..	..	..	..	..	1	..	..	3
Trunk Factories	2	1	1	..	..	..	..	..	..	..	1	..	..	5
Umbrella Mfg	..	..	..	..	..	..	..	..	1	..	..	..	..	1
Vacant Buildings	1	1	..	1	..	..	..	..	..	..	..	..	..	3
Wall Paper Factories	..	..	1	..	..	..	..	1	1	..	1	..	..	4

	Water shut off sprinklers.	Generally defective equipment and unsprinklered portions.	Defective water supply or supplies.	Sprinkler system crippled due to freezing.	Slow operation of dry system or defective dry valve.	Slow or defective operation of high test heads.	Faulty building construction, concealed spaces, vertical openings.	Obstruction to distribution.	Hazard of occupancy too severe for average sprinkler equipment.	Sprinkler system crippled by explosion.	Exposure or conflagration.	Plugged heads.	Miscellaneous.	Total.
Warehouses	17	6	4	..	3	..	2	4	3	..	..	..	4	43
Waste and Batting Mills	7	4	4	2	..	1	..	2	2	..	..	..	1	23
Waste Paper and Rag Shops	7	1	1	..	..	..	..	..	..	..	..	..	2	11
Weaving Mills	1	2	2	1	..	..	..	1	..	..	..	..	..	7
Window Shade Factories	..	..	..	1	..	..	..	..	1	..	..	..	..	2
Woodworkers, Class A*	12	10	4	..	1	1	1	6	1	3	3	1	4	47
Woodworkers, Class B*	6	9	3	2	1	2	1	1	..	3	2	..	3	33
Woodworkers, Class C*	5	4	3	..	..	..	..	3	..	..	..	..	..	15
Woodworkers, Class D*	2	10	..	1	1	..	..	..	..	2	4	..	3	23
Woodworkers, Class E*	5	2	1	..	2	1	2	..	..	..	1	..	..	14
Woodworkers, Class F*	2	..	1	..	..	..	..	1	..	..	..	..	..	4
Woolen Mills	17	19	14	1	..	2	4	..	1	..	3	..	9	70
Wool Scouring Plants	..	1	1	..	..	..	1	..	..	..	..	..	..	3
Wool Storehouses	..	2	..	..	..	..	..	..	..	..	..	..	1	3
Worsted Mills	3	3	2	1	..	..	1	..	..	..	..	..	4	14
Total	602	362	171	50	53	25	93	100	114	84	79	25	131	1889

*See detailed classification of Woodworkers as given in note under Table No. 4.
†See note on Metal Workers under Table No. 4.

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